Journal of Electricity and Western Industry

May 15, 1923

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Journal of Electricity and Western Industry entered as second class matter February 17, 1921, at the post office at San Francisco, under the Act of Congress, March 3, 1879.
Published the 1st and 15th of each month, at Rialto Building, San Francisco, California.

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MAY 23 '23

Journal of Electricity and Western Industry

A McGraw-Hill Publication

Established 1887

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VOLUME 50 | SAN FRANCISCO, MAY 15, 1923 | NUMBER 10

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PUBLISHED SEMI-MONTHLY BY

McGRAW-HILL COMPANY OF CALIFORNIA — Rialto Building — SAN FRANCISCO

James H. McGraw, *President*
C. T. Hutchinson, *Vice-pres. & Gen. Mgr.*
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CHICAGO, Old Colony Building
PHILADELPHIA, Real Estate Trust Building
CLEVELAND, Leader-News Building
ST. LOUIS, Star Building
NEW YORK, 10th Ave. and 36th St.

Copyright, 1923, by McGraw-Hill Company of California. Entered as second-class matter Feb. 17, 1921, at the Post Office at San Francisco, California, under Act of March 3, 1879.

Member Audit Bureau of Circulation
Printed in U. S. A.

McGRAW-HILL CO., Inc., New York
Publishers of

American Machinist—European Edition
(*Published in London*)

Industrial Engineer
(*Published in Chicago*)

Chemical and Metallurgical Engineering
American Machinist | Ingenieria Internacional
Electrical World | Electric Railway Journal
Engineering and Mining Journal-Press
Bus Transportation | Engineering News Record
Coal Age | Electrical Merchandising | Power

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Another Milestone Passed

IN many parts of the West, particularly in California, water power sites are located hundreds of miles from the large load centers. Hence long distance transmission of power is a necessary element in the development of water power in that state at the present time, since most of the close-in sites have been brought into production. Plants now being built and those projected to take care of the future demands for power are located from 150 to 240 miles from points where the power will be used. The cost of bringing this power to meet the rapidly increasing demand for it would have been prohibitive under the voltages of a few years ago.

ENGINEERS, after determining the carrying capacity of circuits of different voltages, decided that transmission of electrical energy at two hundred and twenty thousand volts was the most economical solution of the problem. Since the capacity of a 220,000-volt circuit is four times as great as that of a 110,000-volt circuit and the losses are only half as great in the case of two-circuit tower lines, it was decided that with properly distributed synchronous condensers 220,000-volt transmissions could deliver power over distances of 400 or even 600 miles with good efficiency and at not prohibitive expense. But many mechanical difficulties had to be overcome before a practical realization of the theory could be accomplished.

WHILE electrical manufacturers were willing to construct transformers to operate at this high voltage, insulators and oil circuit breakers capable of withstanding the tremendous stresses imposed upon them had to be developed. Within the past two years, engineers working in cooperation with scientists have proven by experiments that 220,000-volt transmission is commercially feasible.

ON May 6 the first actual operation of 220,000-volt transmission under service conditions was achieved by the Southern California Edison Company on its Big Creek lines. It is one of the greatest scientific advancements in electrical development and means much to the users of electric power and light. It insures the commercial development of vast water power resources located at distances from market centers, thereby adding much to the conservation of the water power resources of the world.

THE consumer's interest in this development, which constitutes a world's record, lies in the fact that by the adoption of 220,000 volts the Edison company will save $7,000,000 in investment capital on the existing transmission lines, this being the difference in cost in constructing an additional circuit of 150,000-volt capacity and equipping the present lines for 220,000-volt operation. On the ultimate Big Creek installation, where over one million horsepower is under development for central and southern California, it will save approximately $50,000,000 in the cost of constructing transmission lines. Measured by light and power bills, a saving of $7,000,000 means a saving to the consumer of over $600,000 per year. A $50,000,000 saving on the ultimate development will mean a saving of the light and power bills of approximately $5,000,000 annually.

OF the many economies and advances made by the western power companies in their effort to render the best possible service at the lowest cost, the achievement of electric transmission at 220,000 volts stands out as an event of great importance. It is indeed gratifying to record such instances where scientific advances are put to practical application for the ultimate benefit of the consumer.

Fostering Public Relations by Conducting Inspection Tours

THE trend of events in the public utility field has demonstrated that no organization can hope to survive and prosper unless its "public relations" are such that it can inspire and secure the confidence and sympathetic interest of the public in its affairs. Managing heads of electric utilities realize this and today no other branch of service is being given more constructive thought. The most outstanding evidence of this is the growth of customer ownership of utility securities.

Another means of stimulating an interest in the service of the power company, which one executive has characterized as "a practice which has done more towards cementing our public relations than any other means which we could possibly adopt," is the custom of conducting inspection tours through its various plants and substations. This can be accomplished with little expense, and where the idea has been tried such organizations as school teachers' associations, women's clubs, as well as the general civic and commercial bodies, have responded with enthusiasm. In addition to the personal visits to the plants these organizations welcome speakers who can deliver short talks pertinent to the electrical industry.

The problem of the development of a favorable public regard for the electric utilities, which are in truth community builders, extends farther than the managing heads. It is their duty to see that every employee is imbued with the same spirit. The executive who does not make every effort to develop and cultivate in the minds of all employees the thought that it is their duty to secure and hold the goodwill of the public is lax in his management.

Combine Business with Pleasure— Plan to Attend the Conventions

IN Spring the young man's fancy lightly turns to thoughts of—vacation, for instance. The railroad psychologists, in recognition of this annually recurring phenomenon, flood the mails with alluring folders depicting the joys of forest, stream and mountain. There are the bathing beaches, golf links and trout streams calling insistently from three-color posters to every man who has a drop of red blood in his veins.

"What is so rare as a day in June," to say nothing of four whole days in June, from the nineteenth to the twenty-second, during which the annual convention of the Pacific Coast Electrical Association will take place at the Fairmont Hotel, San Francisco? "Speaking of vacations," as Irvin Cobb might say, what more could one ask than to combine the opportunities offered by this event for recreation, instruction and the good-fellowship inspired by rubbing elbows with one's own kind under the most delightful circumstances?

After registration on June nineteenth there will be moving pictures, illustrative of some phase or phases of electric development, plus an opportunity to cement old and make new acquaintances and get our feet on the ground, so to speak, for what is to follow.

On the morning of the twentieth, President James B. Black will give his annual address, in which he will summarize the activities and accomplishments for the year past, and present his forecast of what the future will hold in store for us.

On the morning of the twenty-first there will be more sessions of the technical and commercial sections, while the afternoon will be devoted to swatting the elusive little white ball over the greensward, punctuated by cries of "Fore," "Out of bounds," and the refurbishing of the usual complement of alibis without which no golfer is complete. Charles C. Hillis is on the golf committee. Enough said.

On the twenty-second, the last day, the second business session will take place, to be followed by the Western Conference in the afternoon, and then, event of events, the banquet in the evening. It would not be fair to tell tales ahead of time about the banquet, but—it will be a banquet of banquets. San Francisco and the San Francisco members of the P. C. E. A. know how. There will be an address, perhaps several short ones, each with a punch. And then between addresses there will be—no, it wouldn't do at all to tell. You will have to come and find out for yourself.

Then on Saturday, the morning after the day before, there will be a trip to the top of Mt. Tamalpais and to Muir Woods, scenic wonders never to be forgotten. And, best of all—better than banquets, technical sessions, golfing or any of the more material pleasures of events such as this—is the joy of contact with one's own kind, the spirit of live and let live, the very essence of good-fellowship that smooths out the rough spots of our daily toil, that marks the line of demarcation between living and a mere existence.

Of equal interest is the Northwest Electric Light and Power Association Convention, from June 27 to 30, in Seattle, where the same hospitality will be manifested and similar problems will be discussed.

The Columbia Basin Project Is of Great Importance to the Northwest

OF great importance to the Northwest is the Columbia Basin Project, which will bring under cultivation 1,753,000 acres of desert land, located at the junction of the Snake and Columbia rivers, in the State of Washington.

To reclaim the vast area in the Columbia Basin it is proposed to store the drainage waters coming from 25,000 square miles in the northern Idaho and western Montana watershed of the Rocky Mountains. Initial storage will be secured in Flathead Lake in Montana, one of the largest bodies of fresh water lying wholly within the United States. Secondary storage is in Lake Pend Oreille, through the Flathead and Clarks Fork rivers. The Pend Oreille River ultimately drains both storage basins.

The point of diversion for water to irrigate the Columbia Basin is at Albany Falls, near Newport, 50 miles northeast of Spokane.

The average annual flow of the Pend Oreille River is 19,000,000 acre-feet, of which 6,250,000 acre-feet is to be diverted for reclamation.

The soil of the vast area to be reclaimed under the Columbia Basin Project is intrinsically rich. It is, generally speaking, a fertile volcanic ash soil deposited in a vast blanket when central Washington was the site of a prehistoric lake.

According to Gen. Geo. W. Goethals, who recently made an investigation of the project:

"The Columbia Basin Project is as much a national one as were the Panama Canal and the Alaskan Railway, and will, if completed, add much more to the national wealth than either of the others mentioned. The work should be provided for and carried out as were these other two national projects—by direct appropriation."

In 1922 the Columbia Rasin Irrigation League was formed, with representatives from Idaho, Washington and Oregon. The project was kept before the proper officials at Washington, with the result that the last Congress appropriated $100,000 for a federal survey, and this is now being made. Appropriations by the next Congress for actual construction will no doubt depend on this report.

General Goethals estimated the cost of irrigating 1,753,000 acres at $145.56 per acre, with an annual cost of 48 cents per acre for operation and maintenance of irrigating system. The soils are among the richest in the world, and with water will be highly productive. The district is served by four great transcontinental railroad systems. It is estimated that a population of 500,000 will find homes and occupations here, and that their efforts will add $200,000,000 per year to the productive wealth of the nation. This population will have an annual purchasing power of $150,000,000.

It is obvious that the electrical trade is deeply concerned with the possibilities for new business that such a project opens up. Millions of dollars will be expended for electrical machinery, equipment, appliances and fixtures, and, once established, the market will be a constantly growing one.

Annual Reports of Power Companies Now Designed for Consumer Owners

HUMANIZING of cold facts and hard statistics for the benefit of the layman, in the annual reports of the various western power companies, is a result of the great increase in security holders among consumers. "In place of the usual uninteresting recitation of facts and figures, presented in a stilted, stereotyped form in years past," says the National Electric Light Association Bulletin, in commenting on this subject, "the reports have taken on an attractive appearance and the information contained in them is presented in readable, understandable English, with necessary tabulations reduced to a minimum and greatly clarified."

Typical of this style of annual report is the "Year-Book" of the San Joaquin Light and Power Corporation which chances to be on the editor's desk at the moment. This report contains an interesting article sketching the part that this company has had in the development of its territory and giving a short history of its growth. Another article discusses the extent and character of the properties owned and operated by the company. In addition, photographs of several generating station and graphic comparisons of gross operating revenue and kilowatt output, are given as well as descriptive scenes of generating stations and applications of electricity. The book also contains a map of the territory served by the company and its subsidiaries, showing the location of existing plants and transmission lines, and indicating proposed construction.

The annual report to stockholders is but a part of the attractive booklet and contains a departure worthy of adoption by other companies. The essential information of interest to stockholders is carefully explained in detail, and each item of the balance sheet has beneath it a short paragraph of explanation. The uninitiated are told in words of one syllable just what such mysterious terms as current assets, deferred charges, surplus and reserves really mean.

The modern annual report is indeed a step in advance and will promote a better understanding on the part of the readers, who are for the most part unfamiliar with the problems of the central station, of how the kilowatt hour is made and sold.

Electric Light and Power Industry Now Among Largest in Nation

THE public utility must not only keep pace with the development of the country, but ahead of it. The service must be there when the population arrives. In order that this may be accomplished the utilities necessarily require a steady life-preserving flow of new capital.

The privately owned electric light and power companies will contribute substantially to the prosperity of the Nation during the current year. More than $600,000,000 will be expended by them for extensions and additions to meet the demand for service.

In 1880 the population of Continental United States was 50,000,000. In 1920 it was 105,000,000, an increase of 117 per cent. The entire capital invested in the electric light and power industry in 1890 was less than a billion dollars. Today this industry has a capitalization of over $5,000,000,000, representing an increase of over 500 per cent, with annual gross earnings of $1,000,000,000. The securities of this vast industry are held by 1,750,000 of the nation's citizens.

The total value of the extensions and additions planned for 1923 for privately owned companies is estimated at $602,000,000. This figure includes central generating plants, transmission and distributing systems, and is approximately 86 per cent more than was spent last year, and $387,000,000, or about 180 per cent more than was spent in 1921.

Additional equipment to generate 2,890,000 kw. will be installed, of which 68 per cent will be in steam plants and 32 per cent in hydroelectric stations.

In 1923, $209,000,000 will be spent to increase the country's steam plant capacity. This is more than double the sum similarly spent in 1922 and more than four times the 1921 figure.

CURRENT COMMENT

California is entering an unprecedented era of activity in development of its water resources, according to the biennial report of the Division of Water Rights of the Department of Public Works. Applications received to date indicate intentions to irrigate 17,000,000 acres, nearly three times the acreage under present constructed systems. Future power development is forecast by the receipt of applications for the development of a total of 9,350,000 theoretical horsepower as against the 1,250,000 hp. constructed at present.

Water Division Report Reveals Interesting Data

Future development of California water resources must depend largely upon storage of flood waters as present projects utilize the greater part of the low flow of the stream. That this is realized is indicated by the fact that there have been received by the Division of Water Rights applications for the storage of 100,000,000 acre-ft., which is fifty times the present constructed storage capacity.

Every phase of the work of the division is described in the report, including the investigations of the super irrigation district on the Kings River which will irrigate 1,000,000 acres of land. The importance of return water from irrigation is discussed in detail, the report showing that nearly 900 cu. ft. per second returns to the streams of the San Joaquin Valley during the summer months.

With no complaint on service or rates, with the company meeting all requirements for a renewed franchise submitted or countered by the city administration, the Colorado Springs Light, Heat & Power Company, a United Gas & Electric subsidiary, is engaged in a battle for its life. Its franchise for supplying power and gas to Colorado Springs and part of the Pike's Peak region in Colorado is about to expire and a new one covering a period of 25 years has been requested and will be voted upon June 12 by the taxpayers of Colorado Springs at a special election, the expense of which must be borne by the central station.

Colorado Utility Threatened With Public Ownership

Street corner arguments, luncheon club discussions, back alley rumors, debates in which strong language is used, all seem to concern the "franchise." Few people are outspoken in its favor, while many vehemently denounce it. The city council, contrary to all precedent, took the lead in this respect by passing judgment on the proposed franchise, and in a resolution of scorching language, telling the voters of Colorado Springs to defeat the measure.

There does not seem to be a fifty-fifty spirit in the matter—indeed, an absence of good sportsmanship is noted. "Kill the light company and make it suffer for the sins of yesteryear" seems to have become the slogan. Few citizens seem to be introspecting and asking themselves if the proposition is economically sound and fair to the taxpayers. And because the city refuses to offer a counter proposition, some citizens are asking if there might be an underlying or ulterior motive. Those are the people who sense the possibility of the city operating the hydro-generating plant near Manitou, which, under the terms of the previous franchise, is passed to the city.

An irrigation engineer has reported ample water to meet all requirements at the plant with certain improvements. The company operates a steam plant and claims the hydro plant and water supply is inadequate. Prominent hydroelectric engineers have supported the latter contention.

Because of the belief established in the special city engineer's report and certain alleged inconsistencies, the company has secured the services of General George W. Goethals and he is now making a survey of the Colorado Springs water situation. It is generally admitted that his report and recommendations will carry considerable weight, providing they are decisive, because of his unquestioned ability and integrity.

The electrical industry of Colorado and especially the utilities are much interested in the situation. Assistance is being given to the company wherever possible. On the shoulders of O. F. Lackey, vice-president, and J. F. Dostal, general manager, and president of the Rocky Mountain Division of the N.E.L.A., has been placed the burden of preventing municipal ownership and operation of their company in the third largest city of Colorado.

Approximately 300 sq. miles of highly mineralized territory and rich farming and grazing land in northwestern Nevada and southern Idaho will be given transportation facilities as the result of the construction of the Idaho Central Railroad, the certificate for which has been purchased by Conrad Wolfle, mining engineer of Oakland, Calif. The line will connect Wells, Nev., and Rogerson, Idaho, and will be ninety miles long.

New Railroad Would Open Nevada Land

A certificate for the construction of the line was issued to Arthur Dunn and George L. Davis of San Francisco in July, 1921, by the Interstate Commerce Commission. They were unable to finance the project and after preliminary surveys were made, the matter remained at a standstill until recently, when the certificate was purchased by Mr. Wolfle. It is expected that actual construction will begin early in the summer.

The town of Rogerson, the northern terminus of the new railroad, is the southern terminus of a branch of the Oregon Short Line, extending from Minidoka, Idaho, where it connects with a chain of cities, among which are Twin Falls, Hansen, Buhl, and several others of considerable size and importance. Wells, the southern terminus, is a point in Nevada, at which both the Southern Pacific and Western Pacific are reached. In the Interstate Commerce Commission docket, the findings of the commission state that the line in question will "furnish a more direct route to California and particularly to the markets of San Francisco and bay cities. Access to San Francisco is greatly desired by shippers and travelers in southern Idaho. The new line will shorten by 311 miles the distance from Twin Falls to San Francisco by one route and 350 miles by the second route, and the inference drawn is that products now being shipped east will be diverted to the California markets."

Conrad Wolfle, the president of the new railroad, is also president of the Riverside mine, and the proprietor and manager of the new townsite of Riverside. He was formerly a mining engineer of Spokane, Wash., and is a member of the American Mining Congress and American Institute of Mining Engineers.

Australian City Will Display New Appliances

The Electric Supply Committee of the City of Melbourne, Australia, will attempt to boost electric housekeeping by the purchase of approximately $5,000 worth of foreign-made electric cookers and other domestic electric appliances which will be displayed in the town hall. It is hoped that by such a display the use of current will be considerably increased. The chief present electric power plants in Melbourne are owned and operated by the city. Rates, which are now comparatively low will, it is expected, be lowered still farther as the result of the completion of a new generating plant. Electric housekeeping is already popular among the more up-to-date Melbournians, and the Electric Supply Department of the city government believes by giving the public ocular demonstration of the operation of heating, cooking, and lighting appliances, it will make their use general.

The Melbourne town hall is located on the corner of Collins, Melbourne's "Main Street," and Swanson Street, which is one of the main avenues of tramway traffic.

The step taken by this Australian community is one that might well be followed in American cities. Such displays, whether maintained by the central station, dealers as a group or the jobbers, is bound to have a beneficial effect on the sale of appliances.

Power Sales Show Marked Increase

Sales of electric power for industrial purposes in the seven western states comprising the Twelfth Federal Reserve District continue approximately 20 per cent greater than a year ago, according to the regular monthly report of the Federal Reserve Bank for that district. Available figures for Feb., 1923, reported by 20 of the principal power companies, show increases in sales in the manufacturing, mining, lumbering, oil producing and agricultural industries, the total increase as compared to Feb., 1922, being 21.7 per cent. Percentage comparisons of sales by certain industries and by sections of the district are presented in the following table:

Percentage Increase February, 1923, compared with February, 1922

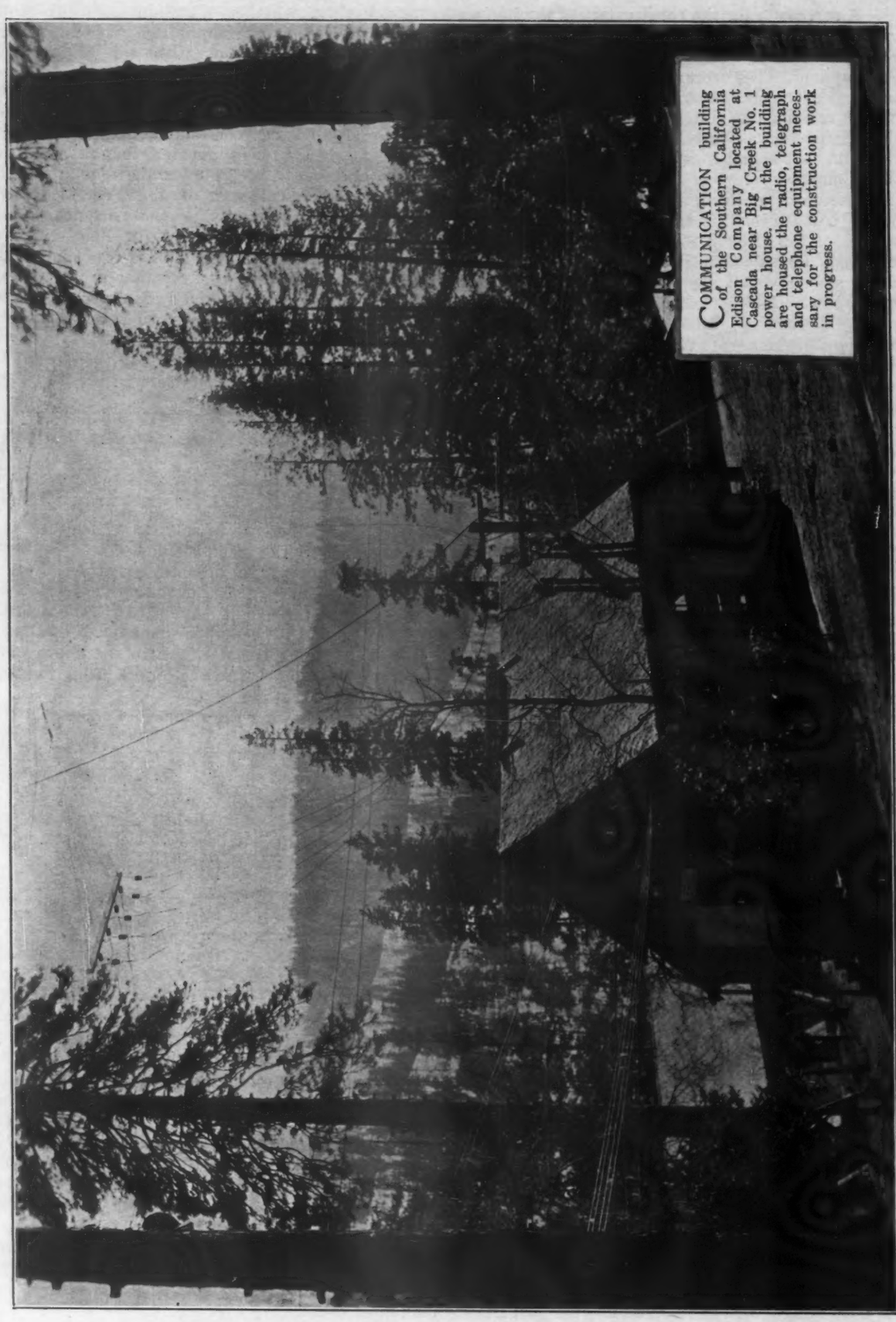
	Agriculture	Mining	Manufacturing	Total Industrial Sales
California	47.3	2.4	33.0	15.6
Pacific Northwest	50.6	21.5	16.7	10.0
Intermountain	79.4	19.6	37.5	91.9
Twelfth District	49.1	9.0	28.8	21.7

The large increase in sales to agricultural consumers is partly the result of the needs of California farmers for power to operate irrigation systems during the recent dry spell in that state, which commenced about the middle of February. The reported increase in sales to the lumber industry of the Pacific Northwest, which is not shown in the above table, was 24.7 per cent, and to the oil producing industry of California, 24.0 per cent.

Figures showing the number of industrial consumers and industrial sales of 20 reporting power companies during Feb., 1923, and Feb., 1922, are shown in the following table. It is noteworthy that, whereas the number of industrial consumers in the Intermountain section is slightly less than a year ago, their current purchases of electric power are approximately double the figures for last year.

	Number of Industrial Consumers		Industrial Sales Kw-hr.	
	Feb., 1923	Feb., 1922	Feb., 1923	Feb., 1922
California	55,919	48,847	163,910,223	141,748,548
Pacific Northwest	14,333	13,385	63,807,405	58,005,918
Intermountain States	4,980	5,427	42,359,847	22,068,438
Twelfth District	75,232	67,659	270,077,425	221,822,904

The figures in the Federal Reserve report are borne out in the case of northern California by data which have been compiled by W. G. Vincent, Jr., vice-president and executive engineer of the Pacific Gas & Electric Company. The figures show that during the past month 4,240 new consumers were added. A total of 11,545 were gained during January, February and March, 1923, as compared with 5,782 for the same period of 1922. During the year ending March 31, there was a gain in connected power load of 34,342 hp., the major portion of which consisted of 11,178 hp. in agricultural motors and 21,739 hp. in manufacturing power, thus indicating a healthy growth in both the agricultural and industrial centers.



COMMUNICATION building of the Southern California Edison Company located at Cascada near Big Creek No. 1 power house. In the building are housed the radio, telegraph and telephone equipment necessary for the construction work in progress.

Power Company Communication Developments

IN the accompanying report of the Sub-Committee on Communications of the Technical Committee, Pacific Coast Electrical Association, three types of communication used by western power companies have been studied. Communication troubles on wire communication lines are discussed, as well as the development of "space" radio and "carrier current" radio as applied to power company use.

THE common agencies of communication now being utilized by the various power companies of this country are, the wire telephone, wire telegraph, "space" radio telephone and telegraph, and, recently, the power transmission line "carrier current" radio telephone and telegraph.

There is no doubt but what each means of communication has its respective application for the various requirements of the power companies, and it is the general intent of this report to briefly outline what application some of the member companies are making of the different methods; mention the principal advantages and disadvantages of each type, and then express a few conclusions.

Since the wire communication systems have been quite highly perfected for some time, little will be said of this system other than to discuss some of the common troubles experienced in this means of communication.

Realizing the need of an auxiliary means of communication to supplement the wire system, when the latter is in trouble or out of service, many of the power companies have turned to "radio" to serve in this capacity. Also, some of the power companies have been utilizing "space" radio for general communication purposes between construction camps and headquarters camps.

During the period that power companies were carrying on experiments with "space" radio, it was discovered that a power transmission line could be used to act as a "carrier" for the high frequency energy of the radio transmitter, provided the transmitting and receiving antennae were properly arranged with respect to the power line. The amount of power required to transmit a given distance in this manner, under normal conditions, when compared to "space" radio, was found to be many times less. This system of communication has recently been quite extensively developed by the General Electric Company and others, and offers a very satisfactory means of auxiliary, and under certain conditions, general communication.

Since most of the "carrier current" installations have been but very recently installed, not a great deal of reliable information is available at this time relative to their actual operation during times of trouble on "carrier line," such as to permit any very definite conclusions being drawn as to the possible ultimate application of this means of communication.

Wire Communication

Communication Troubles on Private Wire Lines:—

1. Communication Troubles Resulting from Storms, Earthquakes, Etc.

Inasmuch as it is impracticable to construct communication lines to withstand extreme storm conditions, this phase of the subject will not be discussed, other than to urge a conservative type of construction in all cases.

2. Communication Troubles Resulting from Inductive Interference.

Due to the usual extreme proximity of the private wire communication lines to the power transmission lines for long distances, often severe inductive interference troubles are experienced in the private wire communication lines.

Since this class of trouble, during normal transmission line operating conditions, can be greatly reduced and often almost eliminated by careful design, particularly as regards

Sub-Committee on Communication:
M. L. Baden (chairman), R. S. Daniels, E. A. Crellin, C. F. Benham, R. C. Denny, H. N. Kalb, R. B. Ashbrook, J O. Case, F. M. Pease, A. B. Vandercook, T. J. Johnson, R. A. Hopkins.

proper transposition of both power and phone lines, some of the experiences of member companies have been solicited and briefly summarized, as follows:

(a) Proper transposition of both power and communication circuits of utmost importance.
(b) Use of copper conductor is urged for all communication lines, particularly for long ones.
(c) Over insulation of line very desirable.

"Space" Radio Communication

As Applied to Power Company Requirements

Communication by means of "space" radio is being utilized by several of the western power companies, among them being the San Joaquin Light & Power Corporation and the Southern California Edison Company.

The San Joaquin Light & Power Corporation* recently made very satisfactory use of two spark-type "space" radio stations for communication between their main office at Fresno and a hydroelectric plant under construction at the mouth of Kern River canyon, a distance of 120 miles.

More recently Mr. Denny, operating engineer of this corporation, has been devoting his spare time to the construction and testing out of an inexpensive radio-phone transmitter of somewhat special design, such as to meet the requirements for power companies' service. A description by R. C. Denny of this transmitter, as well as the San Joaquin Light & Power Corporation's experience with the radiophone, follows:

Cognizant of the need of an emergency means of communication to carry on system dispatching during periods when the telephone lines were disabled, the San Joaquin Light & Power Corporation of Fresno, California, in the fall of 1921 undertook the development of a practical radiophone. The chief requirement in such an instrument was that of consistent operation day or night over a maximum radius of 135 miles from the dispatcher's office at Fresno in a southwesterly direction. The distance requirements in other directions were approximately half as great. Owing to the fact that these shorter distances were over a mountainous country into deep canyons the requirements were nevertheless quite severe.

The fact that transmission was desired in all directions out from the operating center of the system rather eliminated from consideration the "wired wireless" or "carrier current" system due to its limitations. Moreover, the failure of communication is in the majority of cases incidental or secondary to failures of the transmission lines, which would render the "carrier" system useless in case either telephone lines or transmission lines were used for the purpose, and just at the time it was most needed.

Obviously, then, to be practical under the most adverse conditions, emergency communication must be entirely separate and independent of the lines. Manifestly it is only adverse conditions constituting emergencies, that really justify any system of radio, as fully 95 per cent of the time the line telephone system functions properly and is entirely adequate. Therefore, in view of the notorious inefficiency of radio transmission, it would seem inadvisable to use any form of radio where the telephone would suffice, except of course for emergencies.

This is true particularly in the case where radio is applied to systems where telephone lines already exist and where they are strung beneath the transmission lines. It is admittedly a fact that on new projects where long transmission lines are to be built, that the "carrier current" phone system may be used for routine work, over the transmission conductors in lieu of building separate telephone lines and a saving is thus effected, providing the initial cost of the carrier current apparatus is kept within reason. Unless the transmission lines are provided in duplicate it is rather doubtful if the carrier system would suffice in the case of line failures where one or several spans were down, tangled up and grounded.

It is doubtful if the "carrier current" system will be of any great value in emergencies. Apparently, each of the two systems of communication has its own field; the radiophone, where an extensive interconnected transmission network of one, two or three voltages is to be talked over in any or all directions, and the "carrier current" scheme for talking over especially long and important transmission lines where communication is desired only at the terminals thereof. In fact, several companies are adapting the "carrier current" system to certain more important stretches of their transmission system because of the Government radio regulations, which are rather inclined to handicap the use of the radiophone by private corporations, even for emergency operation. Whether it will prove entirely successful with them in emergencies is yet to be demonstrated.

Another requirement to be met in the development of a practical radiophone for emergency use, was that it should not cost more than was commensurate with successful and consistent operation. Another was that it should be simple in operation and adjustments and of low maintenance expense. With these and the distance requirements in mind the writer set about the development of such a radio telephone set. At that time, and with only the experiences of two other radio telephone installations to be judged from, it was decided that a set of 50 watts output rating, if that output be properly modulated, would meet the distance requirements. Advice from several of the large manufacturers that at least 250 watts would be required, and that 1,000 watts was recommended, did not affect the original decision.

From the outset it was decided to eliminate the one item of greatest expense commonly used in such sets; that being the motor-generator set for the production of high voltage direct current. Experiments with an electrolytic rectifier proved conclusively that alternating current could be used, if the resultant pulsating direct current could be sufficiently filtered or smoothed out to minimize, if not eliminate, the fundamental hum. It was soon demonstrated that the chemical device for rectification was inadequate for constant use on currents even as low as 300 milliamperes at 1,000 volts, due to overheating. Besides being very inefficient it was cumbersome and mussy, which rather precluded its use in a compact and finished set. Having served the very useful purpose of demonstrating the possibilities of rectified a.c., it was discarded in favor of vacuum tube rectifiers.

It was also very desirable to use alternating current for heating the filaments of the various vacuum tubes to be used in the set. Besides being more economical than storage batteries, much more simple than low voltage generators, and more easily regulated, it actually results in a longer filament life as the emission is more even from all parts of the filament. In actual service it was found very feasible to use a.c. for this purpose if certain precautions were taken, that is, to bring out the center tap of the transformer winding for connection with the negative high voltage lead which forms the negative or common connection for the entire set. One microfarad telephone condenser should be bridged across from this center tap to each end of the winding, these to serve as a low impedance path or bypass for the high frequency currents from the oscillator tube. Ordinary potential transformers were rebuilt or remodeled for the purposes of filament heating and high voltage for the rectifier. These, too, proved to be inadequate due to overheating when used continuously, but served the purpose of permitting the experimentation to be carried on while properly designed apparatus of adequate capacity was being developed by radio manufacturers.

*See article by R. C. Denny, Journal of Electricity and Western Industry, Nov. 1, 1922. Also Electrical World, Aug. 6, 1921.

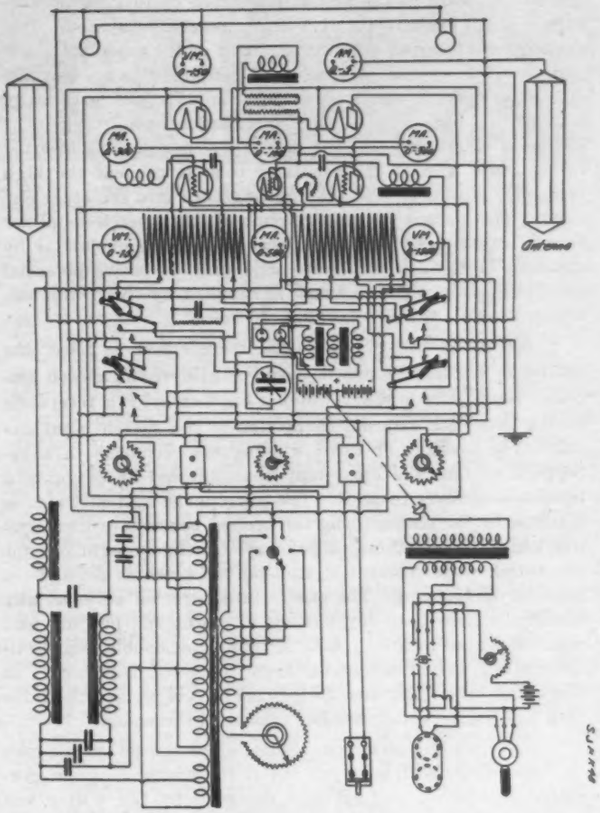
One thing that became apparent in the early stages of the experiments was that of the necessity for low antenna resistance. An aerial and ground system that had been perfectly satisfactory for the spark system of radio telegraphy, employing spark frequencies on the order of 1,000 per second, would not serve at all for the high frequencies of the radiophone carrier wave which was something over 833,000 cycles at the particular wave length at which the experiments were carried on. Accordingly, a counter capacity antenna or counterpoise was designed having the same physical dimensions as the antenna and erected directly beneath the antenna and parallel to it at a distance of 40 ft., this being influenced by local conditions. Every precaution was taken to keep the ohmic resistance as low as possible, stranded copper conductors being used, heavy leads employed and all joints soldered. A marked increase in radiation was the result, practically 3½ times the former current. It was found possible to further increase the radiation by connecting the ground lead to a certain point on the inductance coil, so that with the combination of counterpoise and ground connection, the radiation was four times that obtained with ground alone.

In order to bring in reports from all directions on the operations during the experimental development of the radiophone it was necessary to do a certain amount of broadcasting. Another and fully important reason for broadcasting was that of stimulating an interest in radio among the power house and substation employees about the system. It was considered that such interest was vitally important to the successful future operation of an emergency radiophone service. This was done under an experimental license until a ruling of the Department of Commerce necessitated taking out a special broadcasting license for the purpose. It was thus that the corporation's broadcasting station KMJ came into existence, but with the idea of broadcasting station secondary to the development of the set for use in emergency communication.

After many months of delay occasioned by the inability to get satisfactory tubes and apparatus, hardly any of which were more than out of the experimental stage and on a production basis, a complete set of standard parts was evolved. A satisfactory filter system had in this time been developed, utilizing the primary winding of a 1-kw., 2,300-volt distribution transformer as a choke, the two coils each in series with one side of the rectified high voltage supply. Three one-microfarad condensers insulated for 1,750 volts were shunted across this circuit on the power side and one on the radio side. A special but standard transformer of 750 watts rating was used for the one source of power. This transformer has one primary winding with taps for operation on from 102.5 to 115 volts, and three secondary windings, two of which give 10.5 volts for filament heating and one 3,000 volts for the rectifier tubes. Each of these secondary windings has its center tap brought out, which connection is absolutely essential. It was found in actual practice that this transformer, which is of the dry type, when operating continuously at just full load for an hour at a time became dangerously hot. For this reason it was necessary to rearrange the terminal connections, solder on long leads and saw out sections of the end shells to prepare the transformer for operation under oil. It was put into a 1-kw. distribution transformer case, submerged in oil, and the operation since has been entirely satisfactory. Owing to the primary voltage sometimes going above the transformer voltage rating, a 40-ohm rheostat was provided in the primary circuit. Power for the set is supplied from the 115-volt lighting circuit of 60 cycles frequency. Entering the set through a fused knife switch it passes through a flush-type lock switch to the main power bus and thence to the bracket lamps and a.c. voltmeter. This meter indicates which voltage tap to work on, so the tap selector switch is moved to the proper point and with the primary resistance all in the flush push switch is snapped on. The primary resistance is then cut out gradually and the set brought up to normal operation.

Power tubes of 50 watts output rating are used, one as an oscillator and the other as the modulator. The constant current system of modulation is used in connection with a 5-watt speech amplifier. A special reactor of 300 milliamperes capacity being used in the main positive lead to the plates. The power tubes require at least 1,000 volts on the plates while the speech amplifier tube requires 350.

A resistance of 15,000 ohms having a continuous carrying capacity of at least 50 milliamperes was found necessary to reduce the voltage to the proper value. This resistance was composed of three standard 5,000-ohm resistors. A d.c. voltmeter is provided which by means of a two-pole, double-throw switch may be thrown on power tube plate circuit or upon that of the amplifier tube. The rectifier tubes have an output rating of 150 watts each and the two carry a load of 300 milliamperes at 1,300 volts without undue heating. Two



Wiring diagram of the radio apparatus of the San Joaquin Light & Power Corporation

standard rheostats of 15 amperes continuous carrying capacity are provided, one for each set of tubes that operate in multiple. An additional rheostat is provided for the modulator tube which sometimes requires a slightly different adjustment than the oscillator. A separate rheostat is provided for the speech amplifier tube which requires considerably lower voltage for its filament. The constant potential method of filament control is used rather than maintaining the constant rated current throughout the life of the tube. It is found that this method greatly prolongs the life of a

tube, as the current is automatically reduced as the filament resistance increases due to disintegration. An a.c. voltmeter is provided for this purpose which by means of a two-pole, three-way switch may be thrown upon either the rectifier tube bus or the power tube bus or onto the speech amplifier tube and the voltage adjusted by means of the respective rheostats. The plate current of the oscillator and modulator tubes and the speech amplifier tubes are indicated separately by milliammeters and collectively by one meter which gives the total load on the rectifier tubes.

In the oscillatory circuit are utilized two standard inductance coils of 25 turns each, two fixed-capacity 3,000-volt mica condensers of .002 mfd. each, one variable mercury mica condenser of .0012 mfd. insulated for 4,000 volts, and one 5,000-ohm resistor which is used as a grid leak on the oscillator tube. One of the inductances is to be used as a loading coil for long wave work, while the variable condenser is for short wave work, either of which may be introduced into the counterpoise lead by the proper operation of a two-pole durable throw switch. Another two-pole, double throw switch is provided which is used to either connect the antenna and counterpoise to the active inductance or to ground them both. Small choke coils of 1-henry reactance at audio frequencies are inserted in the grid circuit of the modulator tube and the plate circuit of the speech amplifier to prevent the dissipation of the audio frequency impulses and practically forcing the effect of the speech amplifier upon the grid of the modulator tube. A radio frequency choke coil is inserted in the plate lead of the oscillator tube to prevent the high frequency output of that tube getting back into the other circuits. The output or plate circuit of the speech amplifier tube is capacitively coupled to the grid of the modulator by means of a ½-mfd, 1750-volt condenser. Negative potential for the grids of the two tubes is supplied by small dry batteries, the values approximating 30 volts.

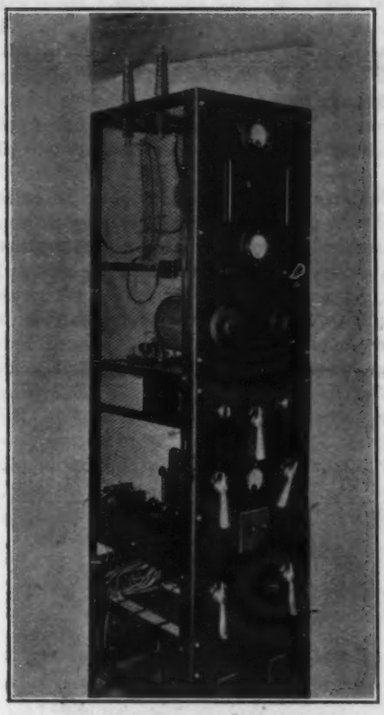
A three-winding modulation transformer is used, the secondary of which connects with the grid of the speech amplifier tube. The primary winding connects with a receptacle on the panel for external connection to the speech input circuit. The tertiary or third winding also connects to a receptacle so that the input may be monitored by plugging a telephone receiver in on it. The microphone system which is external to the transmitting set proper, consists of an induction coil with center tap of primary winding brought out for connection with differential transmitter which is a hand set used for announcing. The other transmitter is an especially sensitive device used for picking up vocal and instrumental music rendered in the studio. A four point double throw telephone key switch serves to throw from one transmitter to the other, while the one battery and rheostat are used for both transmitters, the rheostat to control the volume.

So much for the detail description of the set, which may be followed through with the aid of the wiring diagram presented herewith. The set was designed by the writer and built up switchboard style in the shops of the Corporation as illustrated in accompanying front and interior photographs. The fact that the set is principally used for broadcasting does not mean that it contains any special features except the pickup transmitter which does not materially add to the cost of the set. In fact, built of standard parts as it is, there is no reason why the set can not be duplicated by any of the power companies having even meager shop facilities, at a total cost of $750. It may be built for less but hardly in such compact shape. It would be inadvisable to reduce the cost by eliminating any of the meters as they are very essential to the proper adjustment of various circuits. Needless to say, the set may be used for carrier wave transmission just as well as for radio, with certain additional apparatus for transferring the output to the lines.

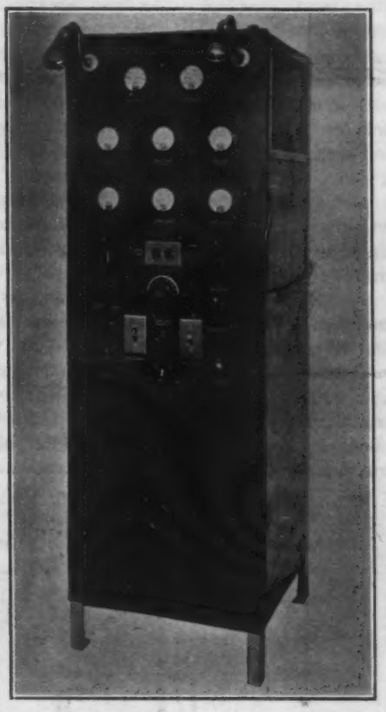
Operating at normal power input rating, on a 4-wire flat top T-type antenna 75 feet high and 175 feet long and a counterpoise of similar dimensions, this set has a normal radiation of 4 ampheres at 360 meters, which is indicated by a radio frequency ammeter of the thermo-couple type. Modulation, effected by speaking or whistling into the transmitter produces from two-tenths to one ampere variation in the radiation. This is known as the percentage modulation and it is upon this that the voice range of the set depends to a large extent. It is possible to get a higher percentage modulation but hardly without distortion. To briefly summarize the results obtained with this set; of the total number of reports on overland reception of speech and music from same, 2% were over 2500 miles from Fresno, 1½% between 2,500 and 2,000 miles, 2% between 2,000 and 1,500 miles, 7% between 1,500 and 1,000 miles, 51½% between 1,000 and 500 miles and 37% within 500 miles. Practically every report pronounced modulation excellent and volume good. One person at a distance of 700 miles reported hearing ten consecutive concerts which rather proves the operation consistent. On several occasions conversations have been carried on by voice with Portland, Oregon, a distance of 850 miles, and on one occasion with Denver, Colorado, at 865 miles, the latter conversation being overheard in its entirety by a novice in Dayton, Ohio, 2,012 miles from Fresno. The remarkable thing about this record was that the novice used only a simple regenerative detector set without any amplification. These records were practically all made at 360 meters operation and subject to interference from a multitude of other stations broadcasting at the same or very nearly the same wave length. Therefore, it is obvious that operating at much higher wave lengths, which would be the case in emergency operation as limited commercial stations, there would be practically no interference which would allow of very consistent results.

These records might seem to indicate that much more power than necessary was being used to cover the power system in question. Possiby so, but the next size smaller power tube has an output rating of only 5 watts which is obviously not enough. Operating tubes in multiple to increase the output rating of a set is not particularly satisfactory without a complication of controls and meters which immediately runs into an expense. For such reasons it was considered inadvisable to experiment with less than a 50-watt tube; also it was felt that for operation through the summer months such capacity was not excessive.

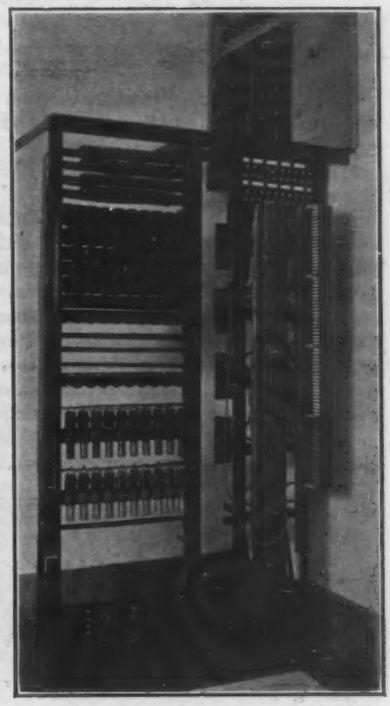
While it was not the intention that problems of reception should be within the scope of this article, the writer desires to remark that in his opinion the success of duplex operation of the radio telephone will depend largely on the receiving end; but after all this is largely a matter of training the operating personnel. Broadcasting is having just that effect, not merely the Corporation's efforts, but broadcasting in general is serving to acquaint the power man with receiving sets, getting him accustomed to the more or less delicate adjustments of the instruments. Numerous receiving tests made about the San Joaquin system have well demonstrated the success of ordinary receiving sets employing one or two stages of audio frequency amplification, connected with outdoor antennae; however, before duplex operation of the radiophone can be any complete success, it will be necessary to resort to loop reception and radio frequency amplification. This will permit stations transmitting at one wave length and while transmitting, receiving at another wave length without interference from their own transmitter. This is the next problem to be attacked, now that much has been learned about radio frequency amplification. A complete receiving set including loud speaking device should not cost



Experimental transmitter of the Southern California Edison Company.



Radio transmitter used by the San Joaquin Light & Power Corporation.



Protection and relay rack in the Communication Building of the Southern California Edison Co.

over $250, making a total investment of perhaps $1000 for a complete two-way radio station.

The Southern California Edison Company now has eight continuous wave radio stations in operation, three of which have been in use almost continuously since Dec. 1, 1920.* An outline description of these stations by R. B. Ashbrook follows:—

"Space" Radio Communication
of the Southern California Edison Company

This company has at present eight radio telegraph stations in operation, five of which are equipped for radiophone service.

The uses of radio communication are at present confined to construction camps only, although experiments are under way to determine feasibility for operation.

The antenna equipment differs somewhat in each installation. They are usually flat top 5-wires, spaced 4 ft. in each case, the length from 120 ft. to 200 ft., depending upon whether inverted "L" or "T" type. In mountainous country we utilize the trees as means of support.

The counterpoise is used where it is difficult to obtain a satisfactory ground.

The average cost for each antenna and counterpoise for our low wave sets (527 meters) is approximately $500. For the 1,650-meter stations the cost would be about $800, but at present we obtain the longer wave length by loading the antenna. The stations in the vicinity of Los Angeles are operating on 1,650 meters and are of ample power and can sacrifice the loss of power in loading without affecting the operation. The wave length of 1,650 meters for this section was occasioned by the great number of stations in this vicinity operating on the lower waves.

All transmitters are of the vacuum tube type, some of which are equipped with phone but C.W. telegraph is being used exclusively.

*Electrical World, Aug. 6, 1921.

The transmitters were purchased from the DeForest Radio Tel. & Tel. Co. in 1920, for $1,500, and are rated at ½-kw. input. They are equipped with two 60-watt vacuum tubes which deliver 6 to 7 amp. in the antenna at 527 meters.

The receiving apparatus is of the regenerative type, with two stages of audio frequency amplification. Our intention is to obtain ample power at the transmitter to require the use of a detector tube only, but in some sections of mountainous country the cost of a transmitter to give this result is almost prohibitive.

The receiving sets were also purchased from DeForest Tel. & Tel. Co. at a cost of approximately $200 and are of the honeycomb coil type.

The geographic conditions affecting operation in rugged mountainous country are very marked. We experience considerable difficulty in transmitting 16 miles, especially at night, although our signals are reported of ample strength to be copied on a typewriter in New York State and the Hawaiian Islands. We expect to experiment this coming summer to determine an optimum wave length which will minimize the reflection loss and consequently reduce the difficulties we are now experiencing.

The results obtained from our permanent installations have been most gratifying in every respect.

Our experience with radio communication has been confined to construction work only and for this class of work the telegraph has proven more satisfactory as numerals are difficult to transmit by phone and if not written are apt to be forgotten or misunderstood. As the majority of construction communication refers to material being ordered, traced, requisition numbers, etc., telegraphy with its written message is preferable.

By employing first-class operators we are not only able to handle a great volume of business but to insure accuracy.

The "space" radio telephone or "carrier current" telephone will undoubtedly prove more satisfactory than the telegraph for dispatching and operating purposes.

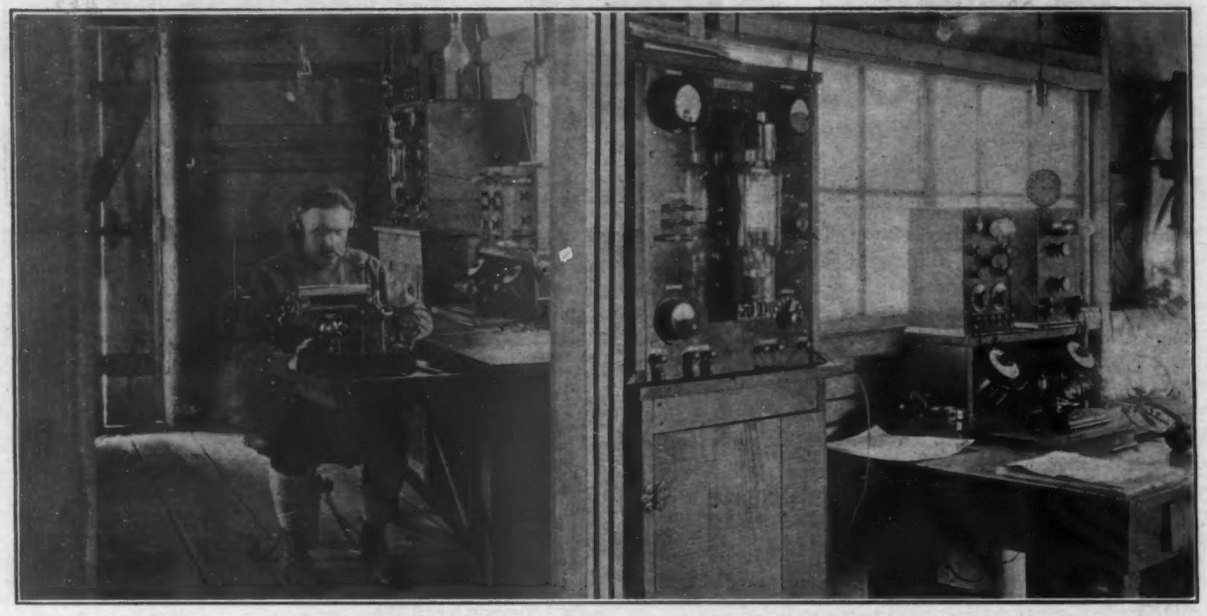
"Carrier Current" Communication
As Applied to Power Transmission Lines

During the last few years considerable research work has been carried out by several of the power companies and electrical manufacturers in connection with the application of "carrier current" radio to power transmission lines. These investigations have brought out some very interesting features of this means of communication, which are treated briefly in the following data:

The Great Western Power Company is now making use of a "carrier current" system in its Oakland-Big Bend transmission line, a brief description of which follows by C. F. Benham:—

"Directed Radio" Telephone Communication System:—Telephony has been adopted as the simplest to operate—and of sufficient reliability.

The system is in use primarily as a regular means of communication between the dispatching organization and the generating stations, with an early extension planned to include the principal transmission substations.



Operating room at Camp 61 of the Southern California Edison Company high up in the Sierra Nevadas (left) and transmitter and receiver at the same camp (right).

Incidentally, the system will probably be in considerable use as a means of communication between the construction force on an imminent generating plant extension and the general office—with one ordinary wire telephone link between the dispatcher's office and the general office.

Coupling System:—The transmission system consists of one double circuit 100-kv. line and one single circuit 165-kv. line paralleling each other on the same right-of-way over the greater part of the distance from the terminal substation at Oakland to the nearest generating plant (Big Bend), some 150 miles, with a 40-mile extension of the 165-kv. line from Big Bend to the more remote plant at Caribou.

For coupling we have employed an antenna strung on the line towers, using a somewhat different placing at the various stations, depending on the topography. At the terminal station we have spanned between the substation and the last two towers of the 100-kv. line—a distance of about 1,800 ft.—with the antenna in the plane of the center conductors. At Big Bend the same general scheme is followed except that a short span of the 165-kv. line is paralleled as well. At Caribou a span is strung across the canyon between the first two towers of the 165-kv. line and directly under the line conductors. A tap from about the center is brought down to the power house, which is directly below. The distance is about 900 ft. here, as at Big Bend. No counterpoise is used—the direct ground being satisfactory.

Various wave lengths have been used successfully, but the best results are being obtained at present between 5,000 and 6,000 meters.

Transmitting Equipment:—The vacuum tube system is used for telephone. Small power tubes (50-watt) have been used with fair success—but in order to have a system that would "punch through" severe interference we have adopted 250-watt tubes as our standard, using one or in some cases two for the oscillator with a 250-watt modulator tube and a 50-watt tube for voice amplification.

A double unit motor-generator set provides 2,000 volts for the plate circuit of the oscillator tubes and 1,000 volts on the modulator tube. A 48-volt dry battery is used for the voice amplifier tube.

Filaments are lighted by a.c. from the regular supply or from a d.c. motor-driven set in emergencies. The d.c. is obtained from the station switchboard control batteries, which also drive the motor of the main 2,000-volt sets and hence the communication system is not affected by operating troubles.

Receiving Equipment:—A standard regenerative type receiving set is used with ordinarily two stages of audio frequency amplification. A loud speaker is multiplied with the usual head phones, and with the receiving set always cut in, serves also as a signaling system. Since there is always an operator on hand no other system has been found necessary; though if there is no immediate response to a call a code signal of considerable volume can be given by means of a microphone transmitter held in front of the loud speaker—connected in the circuit and producing the well known howling effect one gets by placing the receiver of the ordinary phone against the transmitter.

The same antenna is used for sending and receiving with a magnetically operated throw over switch.

Conditions Affecting Operation:—Tests have been made with both of the 100-kv. circuits open at Big Bend and at

Sacramento, which is about half way between Big Bend and Oakland. Also these circuits were grounded at several points. Further tests have been made with various sections of the lines cut out and grounded, but on no occasion as yet with all circuits open simultaneously. In general, opening any of the lines weakens the transmission, but not beyond audibility.

No combinations with transformers in series have yet been tried.

Grounds on the transmission system conductors and in some cases on the primary distribution system feeders, cause some interference and the radio has turned out to be a good "trouble shooter" in consequence—as it indicates trouble before it shows up in any other way on our delta system. Serious grounds are quickly eliminated and cause no extended interference.

But slight atmospheric interference is experienced and only on a very few occasions has it been serious.

Interference from other stations is very rare—though an occasional high power telegraph station is picked up. With the particular wave length chosen and the sharp tuning possible with the receiving sets we use, we have been able to eliminate this.

No 60-cycle interference is experienced whatever.

The results have been very satisfactory and the system is used regularly in place of the private wire phone which was the only method previously available. It has given much better communication than the wire phone, especially over the longer distances—and has proven subject to much less interference.

The Pacific Gas & Electric Company is at this time just completing an installation of a "carrier current" radio communication system on its 220-kv. Pit River transmission line, which is described by E. A. Crellin in the following paragraphs:

The Pacific Gas & Electric Company is now installing and will have in operation about the first of April a "carrier current" radio telephone and telegraph system between the Vaca-Dixon Substation and Pit River Power House No. 1. This system utilizes the twin circuit 220,000-volt transmission lines between the two points for a conducting medium, a total distance of 202 miles, and will be for the sole purpose of directing the operation of the two stations both under normal and emergency conditions. Wire communication is now carried on between the two points but only in a very indirect route requiring several relays and of necessity subject to error and delay.

The system is coupled to the transmission line through a single wire antenna about 1,800 ft. long. This wire is attached to the twin vertical circuit transmission towers at a point on the center line of the tower and at the elevation of the middle crossarm. Six standard 10-in. suspension insulator units are used for dead ending and supporting the antenna. The main station ground system is also used as a ground for the radio equipment. No counterpoise is used. The wave length to be used has not yet been determined and will depend upon the constants of the system and outside interference. It is intended to use not less than 5,000 meters and as much above that up to 25,000 meters as best operating conditions will permit.

The transmitting equipment is the regular vacuum tube telephone transmission equipment similar to that used by the high powered broadcasting stations. Four 250-watt and one 50-watt Radio Corporation of America Radiatron tubes are employed, two of the tubes being used as oscillators and two as modulators with the 50-watt tube as a speech amplifier. The plates of the 250-watt tubes are supplied with a potential of 2,000 volts d.c. from a 2-kw. generator. This generator has two commutators, each supplying 1,000 volts d.c. and a tap is taken off to supply 1,000 volts d.c. potential to the plate of the 50-watt tube. Mounted on the same shaft with the 2,000-volt generator is a 1⅝-kw., 125-volt exciter which also has slip rings for supplying 88-volt, 30-cycle a.c. This 88-volt a.c. is stepped down to 11 volts through a special 800-watt transformer and is used for lighting the filaments of the 250-watt and 50-watt tubes. The generator and exciter are driven by a direct connected 6¾-hp., 115-volt d.c. shunt wound motor. This motor derives its energy from the main station storage battery which is unusually large in order to handle the 220,000-volt oil circuit breakers. Normally the battery floats on the charging set and a contactor has been installed in connection with the automatic motor starter which short circuits a portion of the charging generator field rheostat and permits a rise in generator voltage to compensate for the extra load of the radio motor-generator set. Thus under normal conditions of operation no drain is placed on the storage battery. An automatic motor starter is used for control of the motor-generator set, the starting and stopping of the set being accomplished by taking the telephone receiver off or putting it on the hook. The motor-generator set and special 88/12-6-volt transformer were furnished by the General Electric Company.

The receiving equipment consists of a Colin B. Kennedy Corporation Type 110 Universal Receiver which has been modified to make it a non-regenerative receiver, and a Western Electric No. 10-A loud speaking outfit using two stages of audio-frequency amplification.

Calling is accomplished by mounting a calling microphone in the horn of the loud speaker which, when the calling circuit is completed, will oscillate and howl in much the same manner that the ordinary telephone will howl when the receiver is placed against the transmitter. This gives a very loud note whose pitch will depend upon the natural period of oscillation of the diaphragms and which is clearly audible in all parts of the station. Ordinarily, it is not necessary to use the calling system as the receivers are always in service and the operator near the set so that the loud speaker simply talks at him and he starts up his set and talks back. The system is arranged for a simplex operation and all that is necessary is to operate a small telephone switch which energizes a contactor to connect either the transmitting or receiving set to the antenna, thus permitting talking or listening.

The "carrier current" radio system has not yet been put into operation and it is therefore too early to give data on the effect of varying line conditions. We have no doubt as to its dependability under practically all conditions even with one of the 220-kv. lines down and grounded, and expect to effect communication between the stations under conditions when the wire lines will be out of service.

The Southern California Edison Company (by R. B. Ashbrook):—This company has been very much interested in development of "carrier current" telephone communication, but at present has none in operation.

We have two 50-watt sets for experimental purposes, but deliveries on the generators have been delayed and have not had the opportunity to put them in operation.

There is undoubtedly a great field for this means of communication by power companies and will supplant wire communication in a great number of instances.

The Southern Sierras Power Company carried on a series of tests in connection with "carrier current" radio during 1921-2, and the results of these "carrier current" radio tests, conducted on the 80-kv. Imperial line between San Bernardino and El Centro, and also on 33-kv. system out of San Bernardino substation, are described by M. L. Baden:

During some of our "space" radio testing in the fall of 1916 between Control Station, at Bishop, California, and Rush Creek Power House (a distance of about 60 miles), our attention was attracted to the marked increase of efficiency

of radio transmission when our transmitting and receiving antennae were in a certain relation to the transmission line connecting these two points. A few tests were made at that time to satisfy ourselves of the above point, but the nearness of winter, followed by the entry of this country into the world war in the spring of 1917, caused a lapse of such tests on this company's system until the summer of 1921, when an appropriation covering certain radio tests between San Bernardino Sub and Imperial Valley points permitted us to resume our investigations along the line mentioned above.

Transmitting Equipment at San Bernardino Sub:—

Antenna: In the early part of September (1921) a four-wire antenna, approximately 300 ft. long, was installed between two of the steel poles of the Imperial line, near its take-off from the San Bernardino Sub, about ten feet below the lower conductors of the 80-kv. Imperial circuit.

Ground: A suitable ground was obtained by tying onto several old well pipes located near the transmitting station.

Transmitter: The transmitter consisted of a 2-kva. plain spark-type set remotely controlled from the operator's desk in the substation. (The maximum input used, however, was 1 kva.)

Receiving Equipment: A three-tube non-regenerative set was made up, for the most part from equipment on hand, and arranged for portability.

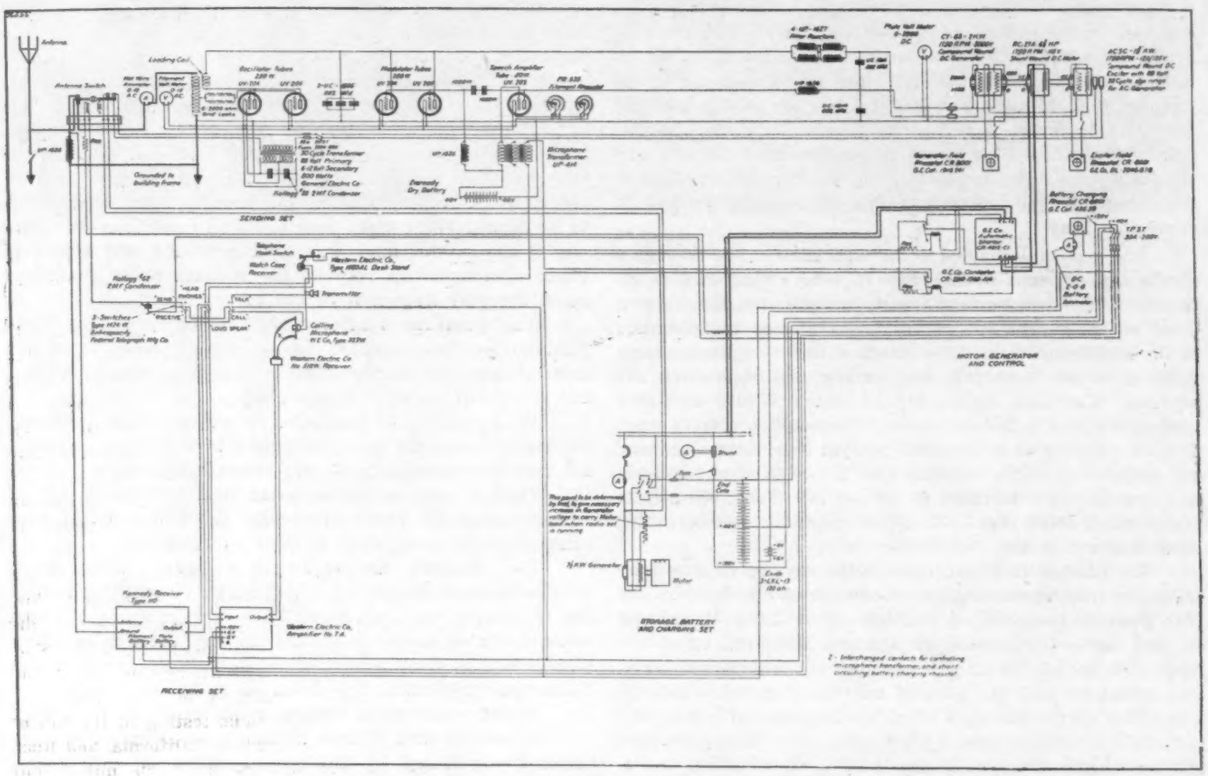
Banning Reception Test:—On September 17 several reception tests were made with San Bernardino Sub from a point on the Imperial line about one-half mile east of Banning Sub (45 miles from San Bernardino). The results obtained were very satisfactory. The antenna used for these reception tests consisted of a No. 10 copper wire, approximately 400 ft. long, stretched between two of the Imperial line poles. The ground used for best reception purposes was a convenient water pipe, but good results were obtained by merely driving a 24-in. bolt into the hard ground near the road and also by using the auto body for a capacity ground.

Coachella Reception Test: On September 22, reception tests with San Bernardino Sub were made at Coachella Sub (90 miles from San Bernardino). These tests proved very satisfactory, signal intensity being ample, using detector and one amplifier tube.

El Centro Reception Tests:—Ordinary Day Tests at Terminal Station: On September 23 several daylight reception tests were made between San Bernardino Sub and the Terminal Station at El Centro (170 miles), under ordinary operating conditions. These tests also proved very satisfactory, ample signal intensity being obtained with two tubes to permit easy reception with the radio receiver located on the operator's desk in the noisy Terminal Station room. Satisfactory reception results were obtainable using but one tube, but due to the noise of the synchronous condenser two tubes were desirable. There appeared to be little or no difference in intensity between Coachella reception and that at Trminal Station.

Tests on 15-kv. system out of Terminal Station: It was then desired to learn whether our radio frequency energy from the San Bernardino transmitter was getting through the transformer windings at Terminal Station into the 15-kv. system out of that station. Consequently it was decided to make a test under the 15-kv. Dixieland circuit near Seeley. Several tests were made at this point using all three tubes, but no trace of our San Bernardino transmitter was obtained, which was pretty conclusive evidence as to what could be expected should we try to work through transformer windings.

Night Tests at Terminal Station, under Special Operating Conditions: Having the desire to learn how our radio transmission efficiency would be affected by opening the Imperial Valley line at some point between San Bernardino



Wiring diagram of the carrier current system of the Pacific Gas & Electric Company at Vaca Substation.

and El Centro, arrangements were made to open the Imperial line at Calipatria Sub at 1:30 a.m. on September 24 and carry the Imperial Valley load with the Calipatria Sub transformers for the short period of our tests. Several tests were made with San Bernardino prior to opening the Calipatria switch, all of which were normal, but as soon as the switch was opened all radio communication was lost. Upon closing the switch again our radio communication immediately became normal.

This test brought to light an obstacle which it was evident would have to be overcome to permit the completely satisfactory application of "carrier current" radio to our transmission system as a means of thoroughly reliable communication.

Elsinore Tests:—After giving some thought to the above mentioned obstacle it was decided to make some tests using what we termed a "bypass antenna" installed at the point where there was an open line switch; this "bypass antenna" serving as a "bypass" for the communication energy past the open switch.

Consequently, such a "bypass antenna" was installed at a line sectionalizing switch in the 33-kv. Corona-Elsinore line near Elsinore and several tests made which indicated that the "bypass antenna" functioned as desired. Also, in these Elsinore tests we found that our receiving station was near enough to the San Bernardino transmitter (about 45 miles) so that it was possible to get good reception with the line sectionalizing switch open without the "bypass antenna" in operation.

Having reached the limit of the appropriation set aside for this work at this juncture of the tests, it was necessary to suspend the work until further appropriations can be arranged for. At that time it is hoped to carry on further tests with the "bypass antenna" used in connection with a transmission line 200 miles long or over, which will enable us to determine the approximate efficiency of such an antenna.

Conclusions:—The above tests have shown us that the efficiency of radio transmission between two points on a transmission line is enormously increased by using the transmission line as a "carrier" for the radio communication

It is apparently inadvisable to endeavor to communicate through transformers or open line switches, particularly on long lines (over 100 miles) without the aid of "bypass antennae."

The reception intensity was so great using the "carrier current" radio system over 170 miles of line that the receiver was used with perfect satisfaction in an open room within twenty feet of a 2,000-kva. synchronous condenser in operation.

The system was found to be almost entirely free from outside interference and from static. The fundamental and several harmonic notes from the transmission lines were always present, but with the receiving antenna properly arranged gave no appreciable interference."

The General Electric Company has been very active in the development of "carrier current" radio equipment such as to meet the requirements of the power companies, and at the present time is manufacturing standard sets of 50-watt and 250-watt output capacity. The price of the 50-watt set complete with receiver and all equipment necessary to constitute one complete station is approximately $2,000, and that of the 250-watt set about $6,000.

The 50-watt set is described in detail in G. E. Instruction Book No. 86948, but data on the 250-watt set is not available at this time.

Radio Broadcasting Service to Public by Power Companies

"Space" Radio Broadcasting by Power Companies:—Broadcasting of music and subjects of interest to its consumers, by "space" type radio broadcasting stations, is being accomplished by several of the power companies of this country, but so far as is known at this time, is not being used to any very great extent.

"Carrier Current" Radio Broadcasting by Power Companies:—Broadcasting over the power distribution systems has been successfully accomplished in several instances, particularly by the Wired Radio Co., Inc., over the electric distribution system of the Potomac Electric Power Company in Washington, D. C., and vicinity. In one of its recent demonstrations a 500-watt radiophone transmitter of somewhat special design was installed in the Georgetown substation of the Potomac company, and its output transmitted to the 2,300-volt distribution lines through high voltage condensers. A number of receiving sets were plugged into lamp sockets, connected to the 115-volt lines in widely separated districts of Maryland and the District of Columbia, and good reception was obtained with simple crystal receiving sets.

The transmitting capacity required was very much less than anticipated, tests indicating that from .5 to 2 watts per square mile of electric lighting network would probably be sufficient to satisfy the requirements.

This system of broadcasting to the public may be applied to advantage in some localities, but it is very doubtful if it will ever be generally used by power companies, since the many "space" broadcasting stations offer such a variety of program that the average "radio fan" will not be content to confine his listening to the program of a single "carrier current" broadcasting station.

Carrier Current Relay Control of Lighting Circuit:—On June 8, 1922, the Lynn, Mass., representatives of the Associated Edison Companies witnessed a demonstration in which superimposed high frequency current was used for the remote control of relays operating a street lighting circuit. The demonstration, carried on by the General Electric Company, was not conducted with apparatus designed for commercial application, but was intended merely to demonstrate the possibilities of such a system as applied to the requirements of power companies.

From the plant of the Lynn Gas & Electric Company, the carrier current system successfully controlled two circuits at Little Nahant, four miles distant, one of these circuits being used at the same time as the carrier guide. The circuit used as a carrier guide is a 3-phase, 4,400-volt house-lighting primary employing a grounded neutral. One phase is tapped off and supplies Little Nahant through two transformers, the average night load of the line being about 15 amp. The carrier current was put upon this line at the central station and running through 6,300 ft. of standard underground lead cable and then by pole line about five miles to Nahant, was taken off at the primary of one of the transformers to operate the control relays. These relays were made to operate eighteen incandescent and two arc lamps on that circuit.

Carrier current brought over the same circuit was arranged to operate relays on a second circuit controlling two 1,000-watt searchlights, two 500-watt flood lights and a pendant lantern. The latter circuit was a 4,000-volt, 4-amp. rectifier series street lighting circuit.

These two circuits were particularly suitable for this demonstration inasmuch as the controlled lamps were plainly visible from the plant of the Lynn Gas & Electric Company.

The carrier current equipment at the electric company's plant consisted of the 50-watt high frequency vacuum tube generator, shown on the accompanying photographs. Power obtained directly from the 110-volt, 60-cycle supply was converted into the high frequency power without the use of a motor generator. The equipment was arranged so that by means of a switch, any one of two or three predetermined frequencies could be adjusted for. The distant lights were turned on and off by setting the switch at different frequen-

cies and holding the operating button closed until there was visual indication across country of the operation being complete, about five seconds being necessary for this. In an equipment designed for commercial operation, some sort of positive indicator would be included.

Legislation Concerning Radio Communication of Interest to Power Companies

"Space" Radio Legislation:—"Space" radio transmitting stations used in central station operation, but not open to public use, are required to operate under a "Limited Commercial License" issued by the Department of Commerce and the operators of such stations must hold a "Commercial Second Grade" Operator's License (or higher). This license requires that the holder thereof will have successfully passed an examination in—

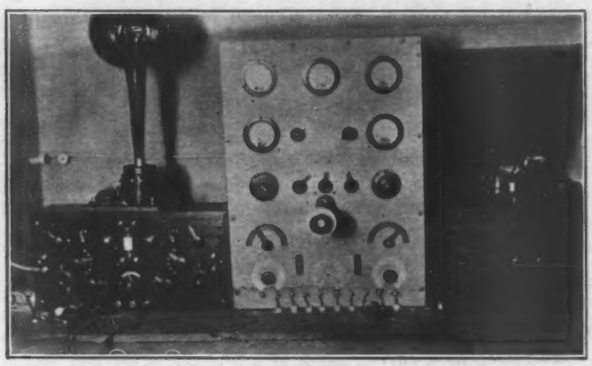
a.—The adjustment, operation and care of apparatus.

b.—Transmitting and receiving by ear, at a speed of not less than 12 words per minute in Continental Morse.

c.—Use and care of storage batteries.

d.—Knowledge of the international radio regulations and the requirements of the Acts of Congress to regulate radio communication.

If such stations interfere with the reception of messages from ship stations they are classed as "coastal" stations and are required to be able to transmit on wave lengths of 300 and 600 meters for the purpose of transmitting or relaying



The experimental radio telephone outfit used by the San Joaquin Light & Power Corporation in conducting their tests.

distress messages or signals and messages relating thereto, if necessary. The operators of such "coastal" stations are required, during the hours the station is in operation, to "listen in" at intervals of not less than 15 minutes and for a period of not less than 2 minutes, with the receiving apparatus tuned to receive the wave length, for the purpose of determining if any distress signals or messages are being sent and to determine if the transmitting operations of the "listening in" station are causing interference with other radio communication.

Copies of the Radio Laws and Regulations may be obtained from the Supt. of Documents, Washington, D. C., for fifteen cents.

"Carrier Current" Radio Legislation:—In neither the existing laws nor in the proposed legislation are there any provisions requiring the licensing of "carrier current" transmitting stations. In this respect the Department of Commerce has taken the stand that until interference with bona fide interstate or international radio communication is reported from "carrier current" operation, no consideration will be given to this method of communication. It is probable, however, that specific regulations covering this method of communication may be drafted at some time in the future, since the locations of some of the "carrier current" radio stations may be such with respect to commercial or Government radio stations as to cause interference under certain operating conditions of the "carrier current" transmitting stations.

Summary of Advantages and Disadvantages of Different Types of Communication Systems

Wire Communication

Advantages:

1. Simplicity of operation.
2. Permits simple duplex communication.
3. Operation independent of topography.
4. Privacy of communication.
5. No station license required.
6. Calling system available.

Disadvantages:

1. Service interruptions from line failures, particularly during severe storms.
2. Service interruptions due to trouble on power line, which the communication line closely parallels, causing intense inductive interference.
3. Repairs of line failures often very slowly and difficultly effected, due to remoteness.

"Space" Radio Communication

Advantages:

1. Entirely independent of all interconnecting lines and their possible failures.
2. Equipment all located at points of operation and thus always readily accessible for repairs when necessary.
3. Usually affords means of communication with commercial or government radio stations in an emergency.

Disadvantages:

1. Transmission efficiency subject to intervening topographic conditions.
2. Somewhat subject to outside interference from other stations in some locations.
3. Subject to severe atmospheric interference in some localities for certain periods of season.
4. Duplex communication expensive and somewhat complicated.
5. Lack of privacy of communication.
6. Station must be licensed and operated by licensed operator.

"Carrier Current" Radio

Advantages:

1. Independent of intervening topography.
2. Much less power required to cover a given distance than "space" radio.
3. Greater freedom from external disturbances, such as static, and interference from other radio stations.
4. Privacy of communication.
5. Station license and licensed operator not required.
6. Call bell system available, not necessitating operator to be listening in to receive calls.
7. Expensive antenna supports and elaborate ground system not required.
8. Little interference created in outside communication systems.
9. Operator may listen to power line conditions.

Disadvantages:

1. Communication subject to interruption when "carrier" line conductors all become severed or grounded due to line failure.
2. Necessary to "bypass" line switches, auto transformers, etc.
3. Necessitates use of large transmitter when applied to a "carrier" system composed of a large network of lines or to a transmission line with a very large number of tap feeders or substations.
4. Duplex communication rather complicated and expensive at the present time when applied to telephony.
5. Somewhat more subject to interference from transmission line disturbances, such as discharging insulators, arcing grounds, etc., than "space" radio.

General Conclusions

Wired Communication, for ordinary routine and load dispatching communication requirements, is usually to be preferred to radio, mainly on account of its present high degree of perfected simplicity. However, it should be supplemented by some means of reliable auxiliary communication, such as "space" radio or "carrier current" radio in order to be of the maximum value to power companies, in cases where almost uninterrupted communication is a requisite.

"Space" radio functions very satisfactorily in such instances under many conditions, and where the distances to be spanned do not greatly exceed 100 miles of average topography and the stations are not located near a large commercial or government station, reliable communication service can be effected at practically all times, without prohibitive installation costs.

Before making "space" radio communication installations in a mountainous country, careful preliminary tests

should be made to determine approximate size of transmitter actually required to guarantee reliable communication under the existing topographic conditions. It is quite a well known fact that "space" radio transmission efficiency varies enormously in mountainous territory, each case usually being a special case.

Also, careful consideration should be given to the choice of proper wave lengths to reduce outside interference to a minimum.

The fact that the stations required to be licensed and operated only by licensed operators is a slight objection, in some respects, but this feature usually insures a competent man, who can be trained for other duties in addition to those of being a radio operator.

"Carrier current" radio—by making use of the transmission line conductors as a "carrier" for the radio frequency communication energy, besides effecting a marked saving in transmitter energy consumption, during normal operating conditions—is not affected by the intervening topographic nature of the country through which communication is being carried on. This makes the "carrier current" system particularly desirable for application to transmission lines through mountainous sections, where the efficiency of "space" transmission is usually very severely attenuated.

The "carrier" type installation, however, cannot be expected to effect communication properly under certain conditions, namely:

1.—When all conductors of the "carrier" transmission line are grounded.
2.—When all conductors of the "carrier" line are severed.
3.—When "carrier" line sectionalizing switches are opened unless such switches are properly "bypassed" by some type of "bypassing" antenna or other device.

In the event of two or more transmission circuits being carried along the same tower line or right-of-way, and being used as a part of the "carrier" system, the chances for all conductors being grounded or severed are somewhat remote. However, in the case of the single circuit transmission line this condition is apt to occur, but the possibilities for continuous operation are much in favor of the "carrier" system, even in this case of application, as compared to the wire communication line, when we consider that a "short," "ground," or "break" of either of the two conductors of the "wire line" will cause an interruption to communication service.

Considerable has been reported in the past relative to the ability of the "carrier current" radio system to effect communication through open "carrier" line switches, past severe breaks in the line and through solidly grounded lines. It is rather the conservative opinion of this sub-committee that such cases are misleading, since it is believed that if they are carefully analyzed it will be found in each case that communication was really effected by "space" transmission, if the distance between the two stations was comparatively short; or else there has been a means of "bypassing" the "carrier" radio energy past the fault, that was not realized at the time of the incident. For example, there may be a twin circuit and single circuit transmission line connecting two points of operation separated a hundred miles or more. All circuits leave the two stations from the same side of the buildings, but the "carrier" antenna is applied to the towers of the twin circuit line, with the single circuit line possibly a hundred feet away. The route of the single circuit line may or may not follow the right-of-way of the twin line. If line sectionalizing switches opening both circuits of the twin lines are operated and tests made, the impression might be gained that the "carrier" system was "jumping" the switch, whereas, in reality it is being routed over the single circuit line; the audibility being appreciably less on account of separation of "carrier" antenna from single line. Similar reasoning will apply in the case of solid grounds on all conductors of the twin circuit line, or even in the extreme case of all conductors of the twin line being severed and grounded.

Also, a nearby communication or low tension power line may possibly serve as a "bypass" if it parallels the "carrier" line at the point of open switches or severed conductors.

Actual tests have been made by some* of the power companies which prove that the antenna of the "carrier" system is a fairly efficient "space" radiator, even when being used as a "carrier" antenna and located very near the transmission line conductors. This fact may have been overlooked during certain "carrier" tests with open line switches, grounds, etc., and reported reception though such faults may have been accomplished in reality by "space" transmission.

"Carrier current" radio functions well, but its efficiency should not be overestimated, and its advantages and disadvantages should be relatively weighed, and compared with those of the other means of communication before an actual installation is considered.

Combined "Space"-"Carrier" Radio Communication System:—It would appear then, that the ideal auxiliary communication system would be a combination of the "space" and "carrier current" radio systems, in most cases. The logical use of such a combined installation would be to utilize the "carrier" system at all possible times; (for reasons apparent from reviewing the "advantages" under "carrier current" radio of the summary), then, in the event of failure of the "carrier" system due to severe transmission line trouble, "throw over" to the "space" radio antenna, increase power output of transmitter, re-tune transmitter if necessary and continue operations.

Naturally the size of the transmitter in this case must be several times what it would be for straight "carrier" service, particularly in mountainous sections. In some cases intermediate stations could be utilized to relay the communication through if necessary, thereby permitting the size of transmitter to be smaller than they would otherwise necessarily have to be to guarantee dependable space transmission over comparatively long distances.

The principal disadvantages of this "combined system" would be that under the present** regulations of the Department of Commerce, stations of this character utilizing a space antenna would be subject to the rules and regulations applying to a limited commercial radio station. This would necessitate the station being licensed and operated by a licensed operator.

Forecast:—With the engineering resources of the foremost electrical manufacturers of our country working in conjunction with the power companies towards the development and perfection of radio communication methods and equipment applicable to power company needs, as they are now doing, extensive progress can be anticipated. Also, many of the power companies are carrying on their own research investigations along these lines and meeting with considerable success. Amalgamating the efforts of the combined working forces then, it can conservatively be expected that a great stride towards the perfection of a practicable and reliable means of additional communication, suitable for the urgent need of power companies, will no doubt be realized during the ensuing year.

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2. Report of Shawinigan Water & Power Company of Montreal on "Wireless Telephone Installation," by A. S. Remison, Tel. Engr. See Reference Appendix, Item 1 of 1922-3, Report Sub-Committee on Communication 1V, P. C. E. A.
3. "High Frequency Telephone for Power Plant," by Dr. Gewecke, Chief Eng. of The Society of Wireless Telegraphic, Berlin. See Reference Appendix, Item 2 of 1922-3, Report Sub-Committee on Communication, P. C. E. A.

*Tests by Southern Sierras Power Company, 1921-2.

**Refer to "space" radio legislation.

Problems in Steam Plant Operation

By E. A. Quinn*

IN its report the Prime Movers Committee outlines practical suggestions as to types of apparatus and methods of operation which have proved successful in Western power plant practice, and recommends that a special study be given to an operating code.

THREE new large turbo-generator installations have been reported to the Committee during the year; one 12,500 kva., one 15,000 kva. and one 17,500 kva. All three of these machines are reported as operating satisfactorily.

Very little blade trouble was experienced among member companies during the year. One member reported an average efficient life of turbine blading as five years. One plant stated that its blading troubles had always been due to mechanical injury, and another cited a failure due to sudden overload. It appears that blading failures are less frequent now than they were several years ago. There is some tendency toward higher steam pressures and temperatures but pressure of 260 lb. and 560-deg. temperatures are far below eastern practice.

Amount of condensing surface reported per kilowatt varies from 1.8 sq. ft. to 2.4 sq. ft. and amount of circulating water per kilowatt, 1.75 gal. per minute to 2.28 gal. per minute. Where sea water is used for condensing the average vacuum reported was 28 in. Where towers or ponds were used the average was approximately 27.5 in.

Some of the member companies who have extensive hydroelectric plants use their generators as synchronous condensers.

The practice among turbine builders today seems to be to make the prime mover powerful enough to carry full load on the generator at unity power factor. There was a tendency about eight years ago to make the turbine a little small for any overload capacity.

There are several eastern plants that are using very high steam pressures on the main turbine and bleeding at about 100-lb. pressure for the operation of auxiliaries. Others are using all electric driven auxiliaries and bleeding the main turbine for heating. One large central station reports that the steam consumption of its main turbines was reduced by extracting at the pressure stages because of the relief it gave to the low pressure stages and the condensers. This extraction idea seems to have great possibilities as one of the great problems in turbine design is the handling of the large volumes and tremendous velocities of the low pressure stuff.

One manufacturer reports that they have under construction a turbine designed to operate with a steam pressure of from 1,000 to 1,200 lb. gage, 750° F. total temperature. This machine when exhausting against a back pressure of 250 lb. will develop approximately 4,000 kw. The exhaust steam is to be reheated and delivered to the steam mains in an existing station.

The general preference among members is for steam driven auxiliaries because of their reliability. Some express confidence in electric auxiliaries where there is a house turbine. The dual drive idea seems to be gaining in favor, both for reliability and heat balance control. Two plants report a separate electric driven spare for two units in addition to steam drive.

The steam jet air pump has become a favorite on the Coast because of its low maintenance cost. Some of the eastern plants are using primary steam jets discharging into dry vacuum pumps. This is said to make considerable saving in power and about the same installation cost as straight dry vacuum pumps.

Our members seem to have no fears of reduction gears in connection with auxiliaries, although some of them have given considerable trouble.

The amount of power consumed by auxiliaries is reported to be from 2.5 per cent to 13.5 per cent of that generated by the main unit. Ten per cent seems to be an average figure. Where there is an abundant supply of circulating water at low temperature the power used by the auxiliaries should be around 5 per cent.

The amount of boiler make-up used is from 2 per cent to 10 per cent. In plants that are equipped for maintaining a heat balance the make-up us 2 per cent to 5 per cent.

The sub-committee on lubrication has obtained data from six power plants, the principal features of the equipment of which are given in table No. 1. It will be noted that the information applied to turbines ranging in capacity from 3,000 kw. to 20,000 kw., of both horizontal and vertical types. Two of the plants use an eastern paraffin base oil, and the other four use a California asphaltum base oil.

Table No. 2 gives a comparison of bases and colors of the new and used oil at the six stations.

Table No. 2
Comparison of Bases and Colors of New and Used Oil

Plant	I	II	III	IV	V	VI
Base	Asph. 90% Par. 10%	Paraffin	Asphal.	Asphal.	Asphal.	Asphal.
Trade Name	Oil No. 1 90% Oil No. 2 10%	No. 1	No. 2	No. 2	No. 2	No. 2
Quality	Medium	Light	Light 50% Heavy 50%	Heavy	Medium	Light
New Oil	Amber	Pale orange	L. Lt. Yel. H. Reddish tinge	Amber	Pale green with yellow tint	Medium red
Used Oil	.....	Reddish tinge	Dark Choc. to black	Dark brown	Nos. 1 & 2 dark, cloudy brown No. 3 clear reddish brown	Dark red

The color of oil is a matter of considerable importance, due to the fact that the color is changed by oxidation. It is therefore very desirable to adopt some sort of a standard scale or code for determining the color of oils so as to bring about uniformity of reports. Special care should be taken to prevent the coloring of oil by accidental means, such as dust, remnants of packing, fringes of gaskets. The use of red rubber in manhole joints, gaskets, pipe flanges, etc., should be avoided as a small amount of such material readily dissolves in the oil and may completely change its color. Moreover, if particles of this material break off, they may plug up the strainers and do considerable damage. The color of the oil

*Prime Movers' Committee: E. A. Quinn, chairman; R. J. C. Wood, J. W. Andree, O. Hilleary, S. J. Kraps, R. C. Denny, A. Y. Meudell, R. A. Wallingford, R. E. Thompson, A. J. Turner, E. E. Valk, M. V. Watson, J. G. Rollow, P. M. Robinson, D. D. Morgan, C. H. Benham, G. H. Bragg, G. Clingwald, F. O. Dolson, V. W. Hoxie, R. S. Masson, R. F. Monges, R. E. Leefeld, S. J. Lisberger, C. E. Steinbeck, R. C. Powell, C. H. Delaney.

Table No. 1

PLANT	I			II					III				IV	V			VI		
Size of Turbine Kw	Tur. 1 12000	Tur. 2 15000	Tur. 3 20000	Tur. 1 3000	Tur. 2 3600	Tur. 3 5000	Tur. 4 10000	Tur. 5 17500	Tur. 4 15000	Tur. 5 15000	Tur. 6 12500	Tur. 7 15000	10000	Tur. 1 9000	Tur. 2 12000	Tur. 3 12500	Tur. 1 9000	Tur. 2 9000	Tur. 3 9000
Make of Turbine	Curtis	Curtis	Curtis	West. Parsons	West. Parsons	West. Parsons	G. E. Curtis	G. E. Curtis	Curtis	Curtis	Curtis	Curtis	Allis Chalmers Co	G. F. Curtis	G. E. Curtis	G. E. Curtis	G. E. Curtis	G. E. Curtis	G. E. Curtis
Speed of Turbine r.p.m.	750	750	750	1200	1200	1800	1800	1800	1800	720	720	720	1800	720	720	1800	720	720	720
Type, Vert. or Horizontal	Vert.	Vert.	Vert.	Horiz.	Horiz.	Horiz.	Horiz.	Horiz.	Horiz.	Vert.	Vert.	Vert.	Horiz.	Vert.	Vert.	Horiz.	Vert.	Vert.	Vert.
TURBINE OIL																			
Trade Name of Lub. Oil	Nos. 2 and 3 Systems 90% Oil No. 1 10% Oil No. 2			Oil No. 1					Oil No. 2				Oil No. 2	Oil No. 2			Oil No. 2		
By whom manufactured	Co. No. 1	Co. No. 2		Oil No. 1					Co. No. 2				Co. No. 2	Co. No. 2			Co. No. 2		
Quality of oil, Heavy, Med., Light	Medium			Light					Alternate shipments of heavy and light				Heavy	Medium			Light		
Base of oil, paraffin or asphaltum	Oil No. 1—Paraffin Oil No. 2—Asphaltum			Paraffin					Asphaltum				Asphaltum	Asphaltum			Asphaltum		
NEW OIL																			
Specific Gravity at 60° F	0.8680 (or 31.3B)			30.5 B					Light .9192		Heavy .9309		?	21.6B		.9235	.9192		
Flash Point Open	385° F.			415° F.					310° F.		335° F.		?	344			310° F.		
Fire Point Open	440° F.			460° F.					345° F.		385° F.		?	374			345° F.		
Saybolt Viscosity at 104° F	138 Sec.			142 (at 100° F.)					126		265		275 (at 100° F.) 100-105 (at 210° F.)	110 Sec. comp. with water at 15° C. 3.66			126		
Saybolt Viscosity at 140° F	75			.....					68		108		Cold test 25° F.	60 Sec. comp. with water at 15° C. 2.00			68		
Color	Amber			Orange, pale					Light yellow to reddish green		Reddish green		Amber	Pale green with yellow tint			Light yellow		
Demulsibility in Water	.....			Good					.....		.....		.....	Not determined			.....		
USED OIL																			
Length of time oil was in service when tests were made	1 yr. 3 months			Some new oil is added as needed to replace evaporation and to replace that drawn from the system for use on auxiliary machinery.					It is impossible to state, as new oil is added as necessary to make up losses.				Sept. 19-22	No. 3 tur. 2 yrs.	No. 2 turbine with make up oil extends over several yrs				
Specific Gravity at 60° F	.....			29.8 B					.9343				.....	.9278		.9371	Spec. Gravity at 120° F. 24.5 Baume		
Flash Point Open	390° F.			418° F.					330° F.				375° F.	335° F.		334° F.	.....		
Fire Point Open	440° F.			465° F.					370° F.				.....	370		370	.....		
Saybolt Viscosity at 104° F	160 Sec.			143 (at 100° F.)					281				.....	147.3 sec.		200.16	.....		
Saybolt Viscosity at 140° F	84 Sec.			.....					105				.....	67		86.8	.....		
Color	.....			Reddish tinge					Dark chocolate to black				Dark brown	Clear, reddish brown		Dark, cloudy brown	Dark red		
Demulsibility in water	150			Good (complete separation)					.....				.....	Not determined			Two hours		
Acidity	0.55%			0.21%					N/400				.....	None			Slight trace		
How often oil is tested	Every three months			Daily for water					Monthly or oftener				.....	As often as appearance requires			Daily		
What method of testing is used	.....			Allow to settle in test tube					Centrifure, titration and viscosimeter				.....	Saybolt viscosimeter grad. cylinder for water			Viscosimeter grad. cyl. for water		

may be a determining indication of its condition. Thus at one station where the oil is a dark chocolate to black color, the oil and water do not separate without treatment. In another plant where the color is light the water readily separates from the oil. In another plant where the oil is slightly darker, it takes a somewhat longer time to separate.

The contamination of the oil by dust is a matter that is often overlooked and should be constantly borne in mind. To avoid this it is essential that oil tanks be covered. Exposure to the air should also be avoided as much as possible, as oxidation is the principal factor in breaking down the oil. Covering of tanks will aid in preventing the aeration of the oil.

In some cases the oil tends to vaporize at points of highest temperature, and where vents are provided and the vapor escapes to the atmosphere, there is a tendency for the oil to become devitalized by evaporation of the lighter constituents. It is advisable, therefore, to arrange vents so as to return the vapors to the oil at some point where it is cool enough to recondense them.

The presence of water in the oil is one of the principal causes of sludge, emulsion and deterioration. Water may get into the oil from the condensation of gland steam. This condensation may be contaminated with mineral salt or boiler compounds where boilers have a tendency to prime. Water may leak into the oil through leaks in cooler coils, unless the coolers are designed so that the oil pressure is greater than the water pressure. This should be done in all cases, and arrangements should be made for the observation of the water discharged from coolers to avoid losing oil in case of leaks. Water may also be formed chemically in the oil by oxidation from the air, and this chemical reaction may be assisted by the presence of dust and impurities. By keeping tanks properly covered, much of this difficulty will be avoided.

Table No. 3 gives a comparison of the amount of oil in the different systems, the quantity of make-up oil, and the filtering capacity.

Table No. 3—Capacity of Lubricating Oil Systems

Plant	I	II	III	IV	V	VI
Oil in system, gals.	8750	1800	6050	800	3800	4650
Capacity, return tanks, gals.	1795	None	7500	....	4084	5875
Make-up oil in 1 yr., gals.	6009	....	7050	....	1800	3000
Make-up oil in per cent of total	40%	....	116 %	....	41%	51%
Oil filtering capacity per hour, gals.	2100	400	1000	600	800	None
Systems independent or interconnected	Ind.	Inter.	Inter.	Ind.	Ind.	Inter.

In plants having more than one turbine there are two different types of systems, one in which the lubricating oil for all turbines is interconnected, the other in which each turbine has a separate lubrication system of its own. A separate system for each turbine appears to be the preferable arrangement. This permits the oil to have a rest whenever the turbine is shut down, whereas with the interconnected system the oil never gets a complete rest unless the entire plant is shut down. It is possible to localize trouble more easily in the case of the independent system, so that if the oil is contaminated, due to some local cause on one turbine, the difficulty will not be spread to the whole plant. It is desirable, however, to arrange interconnection between the different turbines for use in cases of emergency.

The present tendency among turbine manufacturers is to make each machine self-contained with the oil reservoir in the turbine base. This results in some cases in a somewhat limited oil capacity. Much larger oil storage capacity is required in the case of vertical turbines than in the case of horizontal machines, due to the fact that more oil is used in the step bearing, and generally throughout the vertical machine, than in the horizontal machine.

The quantity of make-up oil used per year varies greatly in different plants. In one case as much as 116 per cent of oil is added in a year. In a similar plant, where greater care is taken to prevent contamination of the oil, only 51 per cent is added, and in a third plant where filters are used the make-up is only 41 per cent of the total.

The quantity of oil filtered varies considerably and it appears that the less filtering capacity is installed, the more make-up oil is required.

The quantity of oil cooling varies greatly. In many cases it appears that inadequate cooling surface is provided or else the cooling coils are designed so that they cannot be properly cleaned, with the result that the heat transfer is greatly reduced.

Table No. 4 gives a comparison of oil and cooling water temperatures of the different stations.

Table No. 4
Comparison of Oil and Cooling Water Temperatures

Plant	I	II	III	IV	V	VI
Oil to cooling tanks	157°	120°	150°	142°	135°	132°
Oil from cooling tanks	97	98	140	139	110	110
Oil to bearings	97	98	140	139	110	110
			Vert. Horiz.		Vert. Horiz.	
Oil from step bearing	...	...	150	...	138 ...	140
Oil from tur. bearing	...	...	150 166	...	130 120	135
Oil from mid. bearing	...	...	180 184	...	145 141	140
Oil from gen. bearing	...	...	170 170	...	... 130	...
Water to cooling coils	61	75	72	64	60	58
Water from cooling coils	82	76	78	68	...	62
Water to bearings	...	...	58	...	60	None
Water from bearings	...	64	...	...	71	...
Water to cooling tower	...	80	...	...	70	None
Water from cooling tower	...	...	76	...	60	...
Kind of water	Fresh	Fresh	Fresh	Fresh	Fresh	Salt
Coils in tanks	Iron	.....	Copper	Copper	Iron	Brass

It is desirable to keep a record of temperatures of both oil and water in and out of the coolers, and calculations of the heat transfer should be made at frequent intervals in order to determine the effectiveness of the cooler and to indicate when scale is forming in the coils.

There is a tendency to depart from the former practice of placing cooling coils in the turbine bases of horizontal machines and to install separate tubular coolers instead. Coils placed in the turbine base or in storage tanks are difficult to clean, both internally and externally, and can only be cleaned by shutting down and draining the tanks. If coils are installed in tanks they should be off the bottom of the tank where the sludge collects, as the sludge collecting around the coils interferes with proper heat transfer. The pipe outlets from the coils should run out through slots in the top edge of the tanks, so they can be readily removed and so they will not interfere with the closing of the tank covers. Where brass or copper coils are connected to iron pipes, the connection should be made at a point outside the tanks so that leakage resulting from galvanic action will not cause water to leak into the oil.

The coils should be made preferably of iron, and fresh water should be used as the cooling agent. Where it is necessary to use salt water for cooling, the coils should be of brass. The use of iron coils reduces the electro-chemical action and also the catalytic effect of sludge formation in the oil.

Water cooled bearings are provided with flat copper coils embedded in the babbit. These coils cannot be cleaned mechanically, and owing to the high temperature existing in the bearings there is a tendency for scale formation. These coils should be washed out chemically occasionally to remove the scale. Strainers should be provided to prevent foreign matter entering the coils.

All oil coolers should be accessible for repairs and cleaning. Separate units should be installed and arranged so that one unit can be cleaned without shutting down the turbine. It is important to provide vents on vertical oil coolers, provided with relief valves, to prevent the accumulation of gas or air which may result in the cooler becoming air bound and failing to perform its function. The high pressure used on step bearings on vertical turbines may result in damage to the oil where leakage occurs through the suction valves of the pumps. This permits expansion of the oil through fine streams, atomizing it and tending to crack the oil. If allowed to continue, serious damage may be done to the oil from this cause. When the oil is cracked the impurities present are given a full chance to attack and destroy the oil, particularly so where a large amount of air is present.

Horizontal turbines are ordinarily provided with an oil pump, operated by the main shaft of the turbine, and an auxiliary steam driven pump for use in starting and stopping and for emergency in case the main oil pump should stop pumping for any reason. It is important to provide automatic starting arrangement for the auxiliary oil pump so that it will start up immediately in case the oil pressure becomes low. As a further safeguard, it may be desirable to install a gravity oil tank of sufficient capacity to furnish oil until the machine comes to rest. In case of stoppage of oil flow to the bearings, the machine could be stopped automatically and the gravity tank cut in to prevent damage before the machine comes to rest.

In order to prevent contamination of the oil by air it is desirable to discharge oil into tanks below the oil level, for when the oil discharges at the top of the tank above the oil level a considerable quantity of air is carried down into it. The overflow outlet test holes from the turbine bearings should be kept closed to prevent air being sucked in by the flowing oil. A hinged glass cover may be provided for observation and temperature readings.

Strainers should be considered an essential part of the filtering system and they should be placed:

1. On suction to pumps.
2. On discharge from pumps.
3. On returns to sump tanks.

They should all be of the twin type, to be cleaned during operation. Strainers will catch remnants of packing from step bearing pumps and remnants of gaskets and packing from pipe joints, etc., which are bound to wear off and find their way into the system.

The sump tanks should also be considered as part of the filtering system and the baffles arranged to cause sludge to deposit to as great an extent as possible before oil is drawn to filter.

The baffles should be so placed as to effect a precipitation of suspended matter, and sufficient drains should be provided to draw off sludge and water. It would be possible in designing such tanks to avoid gage glasses as they are very unreliable. Instead a glass insert set in metal of tanks, glass doors in side near bottom could be used for observation. The latter have the additional advantage of being capable of being used for cleaning without removing tops.

Care should be taken that the dirtiest oil and sludge are not drawn to filter. The cleaner the oil the better filtering is accomplished. It is doubtful if the filter is any value when oil is in exceedingly bad condition. The filter cloth in some cases where oil is badly oxidized rots extremely fast, and particularly so on top part, indicating that the functioning of the filter is short circuited. In such cases the oil passes through only the upper portion of the cloth; the dense oil in the lower half appears to be in a state of rest.

Oil to reduction gears on auxiliaries should not be allowed to connect with main turbine oil system as there is danger of water entering through glands on auxiliaries, and also gearing might operate better with oil of a different viscosity.

Absolute prevention of contaminating influence is practically impossible. Therefore limiting the items tending to-

wards injury appears to be the solution, and the most prominent agency to accomplish this result is a means to continually remove water, sludge, etc., even if only of a very slight daily amount. Arrangements to conveniently allow this to be done should be given serious consideration, and special attention should be given to the following points:

1. Proper design of appliances.
2. Proper arrangement at accessible places.
3. Easily accessible for repairs, inspection and cleaning.
4. Strainers and filters of sufficient capacity kept in such condition that they will function to full capacity at all times, greatly facilitated by keeping the oil in such condition that water separates readily and contamination is reduced to a minimum.

Where a chronic condition exists such as water entering and injuring the oil, an unrelenting exertion should be applied to prevent any damage or devitalizing effect to grow on the oil, and an immediate and vigorous research instituted and continued until the trouble is located and remedied.

Operating Code

This is a subject which has been given considerable attention during the last two or three years by the Technical Section, and when the writer was at the Technical Meeting in Milwaukee in September, the chairman of the National Technical Section advised that he realized that consideration of this subject would have to be extended over a long period, but the various geographical sections were asked to give the subject some consideration.

It is generally recognized that in the employment of a definite operating code in the plants of any power system, benefits are certain to accrue. Not only is an operating code an aid to efficiency in operations from the standpoint of economy, but efficiency in plant personnel as well. It makes for reliability of operation by diminishing the injurious effect of frequent changes in personnel. Not necessarily changes in executive personnel, but rather those subordinates requiring executive supervision. Often it is the case that the ideas of some able executive engineer are followed out in practice until a change of superintendents, after which he finds later that operations are deviating from his rules to the detriment of the system.

A definite operating code would go a long way toward improving operating conditions in such cases. It might be found very difficult to formulate such a code on a national basis owing to the different operating conditions prevailing in different localities. Changing conditions in the art and the personal opinions of minor executives would prove difficult obstacles to overcome. Nevertheless, such a code offers many opportunities for putting the best methods of the industry into practice.

First of all, in consideration of such a code it is manifestly necessary that operating men be agreed upon definitions in order to have some ground for comparison of plant or system performance. Accordingly, the work of the subcommittee this year was to confine its efforts to a study of the operating code definitions as submitted by the Technical National Section and to comment on them, offering suggestions and criticisms.

The definitions as outlined fall under six general heads, as follows:

A. Property and Equipment Definitions.
B. Input and Output Definitions.
C. Capacity Definitions.
D. Factor Definitions.
E. Performance Definitions.
F. Auxiliary Energy Definitions.

The definitions as given are confined entirely to steam stations and systems, taking no account of combinations of steam and hydraulic units or plants. Many of the definitions refer to coal only, whereas complete treatment requires that they take account of all fuels, although avowedly the intention to treat of definitions applying to the more complicated operating cases only after the simpler definitions had been agreed upon and to include all other varieties of fuel in the final revision; the effect has, nevertheless, been to rather limit the discussion as among the sub-committee members of the Pacific Coast Electrical Association.

Of the ten members of this particular sub-committee representing eight different power companies comments were received from five representatives of that many companies, indicative of some interest in the definitions after all.

I will not attempt in this report to include all the criticisms of the definitions as outlined by the National Technical Section. The criticisms of our members have been sent on to the National Technical Committee for consideration. This whole subject is one which must be considered by the Central Committee and our assistance in the matter is confined to giving them our criticisms of their definitions. I might add that of the members of the committee who replied, they did not touch, or rather passed over, the great majority of the definitions as accepted by the National Technical Committee. It would appear from this action that the majority of the definitions met with the approval of the members of this committee.

Boilers and Accessories

Generation of electricity by oil fuel has been largely a Western development, and has been employed on so extensive a scale that oprating methods and results may be fairly well standardized for any given set of conditions.

Crude oil being practically the only fuel available in sufficient quantities in this territory at a price justifying its use in industries of this character, this method of generation has been followed almost exclusively, except in certain plants located near the oil fields where large supplies of natural gas as a by-product of the petroleum industry have become available as fuel. In the Pacific Northwest sufficient refuse from the saw mills is available to insure a dependable source of fuel, but even here oil burning equipment is usually installed to supplement the other fuel.

In most cases the object in view in developing steam generating plants in this territory has been the provision of emergency, or stand-by equipment, to supplement the existing water power installations, in order to protect the systems, as far as may be, against sudden physical interruptions and provide a reserve source of power against abnormal periods of low water supply. Another justification of steam generation, peculiarly a problem of the rapidly growing West, is to care for the natural growth of population and consequent demand for electrical energy during the period of construction of water power plants, thus insuring a connected load ready to shift to the hydro plant on its completion sufficient for its economical operation.

Steam plants of this character usually operate at very low load and plant factors. The average capacity factor, or ratio of output to installed capacity, of the plants reporting in this district being as low as 14.87 per cent for the year 1922. The amount of time on stand-by, or operating at light and fluctuating loads, are usually excessive, and periods of maximum demand may be sudden and severe. Such features seriously affect operating efficiencies in the boiler rooms and may easily result in increased maintenance costs as well. It naturally follows that electricity developed from such stations costs materially more per kw-hr. than where generated by water power or by steam plants operating under more favorable conditions, and the reduction of such costs to reasonable figures while maintaining the protection demanded by good service is a very difficult problem indeed for many systems.

As far as the boiler room is concerned, such condition of load and stand-by being determined by outside sources,

the conditions under which it must operate are more or less fixed, and the problem remains to determine the best equipment for such service, or the best method of operating existing equipment, and it was with the idea of discovering the practice of member companies along such lines, particularly regarding maintenance, that your committee directed its investigations this year.

The tendency in these newer installations appears to be towards somewhat larger units, the largest being 1,166 horsepower rating. Stirling type boilers are all equipped to take steam from the back drum, and one company has installed integral economizers. Combustion space has been increased to around 2.6 cu. ft. per rated horsepower and higher settings are used. It is expected the mechanical atomizing equipment will enable higher ratings to be carried with increased efficiency. Tests on the original installation of these burners showed as high as 80 per cent boiler efficiency at 300 per cent rating. The mechanical burner also is said to produce a softer flame with less damage to furnace walls.

A new design of mechanical atomizing burner has recently been placed on the market wherein variations of range is secured by passing oil from a central chamber in the burner, eliminating the necessity of changing tips to secure a change in capacity. The manufacturers claim these burners will operate on from 250 to 1,820 lb. of oil per hour per burner, or a range in steaming capacity of approximately 90 per cent without changing tips. The burners are designed to operate at a pressure around 200 lb., but it is claimed they will give a good spray at pressures as low as 35 lb. per sq. in. Oil temperatures range around 210 degrees for 16 Baume oil, varying somewhat with the gravity and constituents of the oil.

Criticism of old installations include the following:

Units too small, too little combustion space, boilers set below the ground level. Boiler columns and supports located at points where they are easily damaged by fire. Tendency of boilers to prime severely at over loads if concentration is carried at all high, insufficient space in feed water heaters. Feed water heaters set too near the level of feed pumps and electrically operated feed pumps subjected to line disturbances.

A large number of small boilers will require approximately the same number of attendants as the same number of units of larger size, while maintenance and radiation losses will be considerably higher than the same capacity in larger units.

A universal complaint in the older installations has been the limited combustion space allowed, usually between 1.5 and 2 cu. ft. per rated hp., which seriously limited efficiencies at higher ratings. Various methods have been used to increase this space, including straightening fronts on old style Stirling boilers, moving the bridge wall in B & W. lowering the floors and the installation of certain types of patented furnaces.

In the old style Stirling boilers with sloping fronts the supporting column for the top drums was located in side walls at about the point of the most severe action of the fire, and unless the brick work was well maintained was often damaged. When these fronts have been straightened it has been customary to move these columns outward to secure the protection of the front wall, which seems to eliminate all trouble from this source. Superheater hangers, where suspended from the top member, are also liable to damage by the fire and have been replaced by cast saddles resting on the side members, which seem to give better protection.

Stirling type boilers taking steam from the middle drum show considerable tendency to prime when forced much above rating unless the concentration is kept low or the average practice being from 80 to 150 gr. per gal., with a maximum of around 200 gr. per gal., depending somewhat on the nature of the fuel and the per cent of rating carried. Gas fired boilers show a greater sensitiveness in this regard, due to the greater cleanliness of the tubes with the consequent greater heat absorption in the first pass. One company has successfully changed the outlet on its boilers from the middle to the back drum and report good results.

Many of the feed water heaters installed were equipped with extremely small storage capacity, giving little reserve for the pumps in case of fluctuations in supply, and some of the newer installations are making more generous provision in this regard. Some heaters were also installed with very low suction head to the pumps, making operation troublesome when temperatures were raised to around 212 degrees.

When electric driven boiler feed pumps obtain current from the main distributing system they are subject to its disturbances, and while serious trouble from this regard is extremely rare, it may at times of severe overload with frequency considerably below normal, result in considerable difficulty in getting sufficient water to the boilers. Where equipment of this kind is used, reliability makes it desirable to have either auxiliary steam equipment or a separate source of electric power.

At no plant in this district is any effort made to approach the high ratings carried by the Eastern plants, the average in practice being around 150 per cent, with a maximum of about 200 per cent, which appears to be about the maximum attainable with the older equipment using steam atomizing burners, the limit being set, apparently, by the ability to obtain a sufficient admixture of air and the temperatures the furnace linings are able to withstand.

Mechanical atomizing equipment being installed in plants under process of construction will probably allow higher ratings to be carried when desired, but no data is as yet available.

The following table, giving size and type of boilers and ordinary and maximum ratings carried, show operating practice of plants in this district:

Plant	Size of boilers	Type	Ordinary rating carried	Max. rating carried
A	Oil & Gas (777 & 850)	Stirling	160%	190%
B	Gas (822 Stirling) (825 Connelly)	.....	135%	190%
C	Oil & Gas (640 h.p. Stirling) (640 h.p. B. & W.)	.....	150%	200%
D	Oil (520 & 1200 h.p. B. & W.)	.....	150%	244%
E	Oil & Gas (535 & 890 Stirling)	.....	140%	150%
F	Oil (500 h.p. Stirling)	.....	10% (standby)	200%
G	Oil (823 h.p. Stirling)	.....	110%	250%

Perhaps the greatest upkeep cost of many boiler rooms occurs in furnace repair, which when neglected may affect operating efficiency and even result in serious damage to steel supports and boiler structures. An analysis of costs of this work in one plant of 19,000 boiler hp., operating 24 furnaces, gave an average over a three-year period of $.086 per 1,000 kw-hr., or $426 per furnace per year, where furnaces were maintained in good condition and boilers were operated around 150 per cent of rating. These furnaces had all been operated over ten years without rebuilding, so the above figure probably represents about the average yearly maintenance for this work at this plant. Sufficient data were not available to get comparative cost of this work, but it would probably be found to depend largely on the percentage of rating carried and hours run.

Unfortunately, the grades of fire clay available on the Pacific Coast do not produce a very dependable furnace lining, and the price of eastern fire brick in this locality makes their use prohibitive. All plants reporting used brick of local manufacture, and all, with one exception, expressed a desire for brick of higher refractory qualities.

An effort has been made by at least one manufacturer to meet this demand by treating local clay in the electric furnace, regrinding and burning into a brick from which practically all fusible material has been eliminated. Brick of this type will easily withstand the temperature encountered in the boiler furnaces, but sometimes show considerable tendency to spawl after prolonged use.

Several companies reported the use of one or more of the brands of plastic fire brick to a limited extent, and comment on this material was universally favored. It is easily applied, results in a very tight wall, free from joints, and has little tendency to slag or run. Its higher price, however, restricts its use to points of severest deterioration. One company molds the checker work and furnace floors from this material as well as using it in the side walls. Others have found it useful in repairs and small patches that would not justify relaying a considerable portion of wall.

Condition of service and feed water vary considerably—also the amount of upkeep of drums and tubes for different localities—but for companies reporting in this district the length of time between cleaning varied from four to six weeks, or approximately 1,000 hours actual service where water is not treated, to from six to twelve months where water softeners are used. Internal methods of cleaning include the usual turbining of tubes and scraping or brushing of drums, followed in many cases by the application of some form of in-

side paint, "Spartain" being the brand most commonly used, others being graphite and kerosene (below the water line) and zinc oxide and kerosene above the water line, and graphite and marine engine oil (principally rape seed oil). The frequency of application varied from three months to a year. Only two cases of internal pitting were reported, evidently caused by oxidization due to air dissolved in the water. These were corrected by the use of the internal paint, which also prevents to some extent the adherence of scale to the shells.

Several cases of external corrosion of drums and tubes were reported due principally to admixture of moisture with collections of soot. A chemical analysis of soot from the rear pass of an oil fired boiler gave the following results:

Carbon, etc.	51.15%
Silica (Sio_2)	1.89%
Iron (Fe_2O_3)	12.50%
Calcium (CaO)	0.60%
Magnesium (MgO)	0.20%
Alkalies (as NaO)	6.24%
Chlorine	trace
Sulphate (as SO_3)	27.42%
Total	100%

The acidity of the material calculated as sulphuric acid is 21.13 per cent. It is seen that approximately only half the material is really soot in the sense of unburned carbon. Sulphur in the oil is responsible for the formation of sulphates, which upon the addition of water, results in the attendant action upon shells and tubes. The remedy consists of stopping the leaks where possible and cleaning and painting the shells with red lead and oil, graphite and oil, or Spartain external paint, usually applied with an air spray.

The tube renewals in most of the plants reporting were extremely small, ranging from nothing to from five to seven tubes per boiler per year, the higher number being in plants that had been in service from twelve to fifteen years. The principal losses occurred either in the front banks, where tubes were subject to the more intense heat, or at the lower ends of the rear pass tubes, where leakage from super heaters caused excessive corrosion. This latter has caused extensive tube renewals in some boilers, where superheaters have been neglected.

All plants in this district where operation is at all continuous have installed soot blowers of either the Diamond or Vulcan manufacture, and uniformly report good results, except in gas fired plants, which have no soot to blow and do not use the blowers except when changing to oil.

The earlier installations consisted of eight or nine blower units, distributed through the boiler passes, but recent practice has shown a tendency to limit their use to the second and third pass, installing either three or four units. This arrangement has been found to remove the heavier soot deposits and eliminate the frequent replacement of warped and burned units where they were installed in the hotter parts of the furnace, and while materially reducing the original and maintenance cost of the installation, reduce the flue gas temperature to within 35 to 50 degrees of the complete installation.

Some cases of warped and sticking units were reported with the old style heads, which have been eliminated in the new valve in head type, which also reduces the amount of steam used in blowing to a minimum.

Frequency of operation varies from every eight to twenty-four hours where boilers are operating fairly continuously to once a week on stand-by service. The attached curve shows increase in flue temperatures per hour after blowing on a Stirling boiler equipped with nine units of Diamond blowers, the boiler operating at a fairly constant load of approximately 150 per cent rating.

It will be noticed that the first 10 or 15 degrees temperature rise occurs fairly rapidly during the four or five hours following blowing, followed by a more gradual rise of approximately 15 or 20 degrees more during the remainder of the 24 hours. The second curve on the same sheet shows

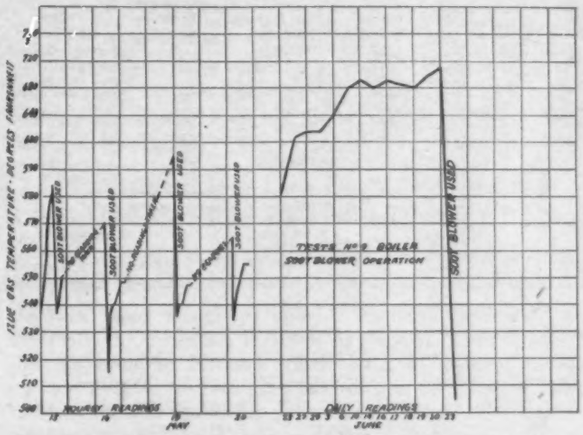


Diagram showing the results of blower tests on one boiler.

the effect of discontinuing their use over a period of three weeks, during which time the temperature rose fairly uniformly during the first 17 days to approximately 150 degrees above the average when the blowers were used, after which it held fairly constant during the remainder of the time, returning again to the original figure upon the resumption of blowing.

Some trouble was reported, due to leaky caps in superheater drums, the seats having become scored or pitted. Remedies have included rolling in plugs, the most satisfactory being made of short lengths of tube welded shut at the top, welding plugs into the drums, and the use of some of the brands of Hot Joint paste on the gaskets. Excellent results are reported from the latter practice, using manganesite. Another indirect remedy consists of installing thermostatic traps on the superheater drains to eliminate the accumulation of water in the drums. Such leaks are a source of considerable deterioration to drums and tubes during periods of stand-by, and may result in serious damage if allowed to continue over long periods of time. No excessive losses of pressure through superheaters were reportd, the average being from 2 to 7 lb., the latter at approximately 185 per cent rating. It is understood that one company had some difficulty in this regard and substituted nozzles for the usual cores on the saturated side, with good results.

Plant arrangement determines quite largely the number of attendants necessary in the boiler room, and it is often the case where additions have been made that the new boilers are placed in such manner, or so remote from the older installation, as to render it impossible for one man or one crew to attend both units, even where the amount of attention would not be large. The location and types of pumps and auxiliaries also sometimes require extra attention, as well as the nature of the load the plant is expected to carry.

Where conveniently arranged, the usual practice seems to be about one man to every eight boilers, or a fireman and water tender to 18 boilers, per shift. This would also call for the presence of some one in addition qualified to investigate and care for unusual cases of trouble, and would include the necessary attention to the boiler room auxiliaries.

Division of duties also varies in different plants, in some it being the practice for one man to both fire and tend water on a certain number of boilers, while in others the

firing of a larger number of boilers constitutes one man's duties, while the water is looked after by another.

The following table shows the practice of companies in this regard:

Boiler hp.	No. of boilers	No. firemen per shift	No. water tenders per shift	Other attendants
19,000	24	2	3	1 senior fireman
3,500	7	1	1	General foreman charge of operation & repairs
13,250	28	3	(Two boiler rooms in the same plant)	Two extra men on 11 to 7 a. m. shift blow down and get concentration test
5,340	6	2		
		1 fireman to 6 boilers	Water tender cares for pumps and heaters	
7,380	12	1 fireman on 8 oil burners 4 on 4 lamp black boilers		

While performance of boiler equipment under test conditions is easily reduced to standard conditions, it is a more difficult problem to develop any standard of operating efficiency by which to measure the actual results secured in practice that will include the varying conditions of load, type of appartus, stand-by, fluctuations, etc., which have a considerable influence on the kilowatts per barrel produced.

Practice of companies reporting varied from practically no comparison except the logged output, through short daily and monthly summaries of kw-hr. produced, fuel used and other principal operating features, to the more elaborate efficiency sheets where as many factors as possible affecting plant operation are calculated each day and plotted in a series of curves tracing the variations of all metered quantities.

Another and generally used method is that of referring daily results to a standard curve of plant efficiency, where kilowatts generated are plotted against oil burned, data for the curve usually being obtained from past plant performance. Daily or shift results are referred to this on the basis of 100 per cent operating efficiency for points falling on the curve and corresponding lower or higher values as points are above or below the calculated values.

These methods are open to the objection that the time element or turbo hours and reserve boiler capacity are not allowed for. And it is obvious that the same operating efficiency could not be expected of a plant with three turbines in operation carrying a load considerably below the rated capacity of one machine that could be expected with only the one machine running.

A modfication of this method, including a correction for turbine hours, is in use by one company which reports

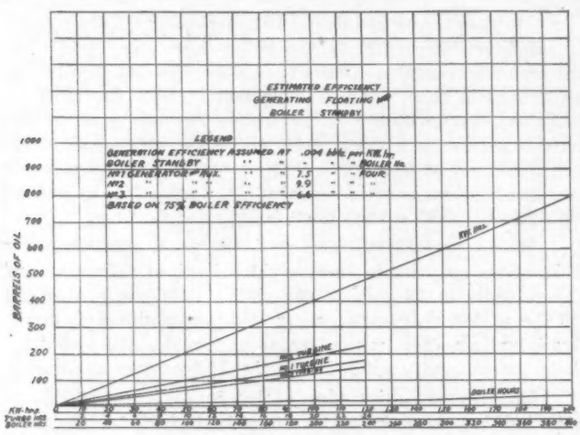


Chart showing estimated efficiency, described in the text as Sheet 1.

a gain of 10 per cent in operating efficiency in two years through interest stimulated in this manner.

Sample sheets are attached of a development of this idea, including allowance for number of boilers in service and turbine hours run by units of different size and efficiencies. This gives a remarkably good analysis of daily operating conditions, is easily prepared and affords perhaps as accurate a yard stick as any by which to measure plant economy under extreme variations.

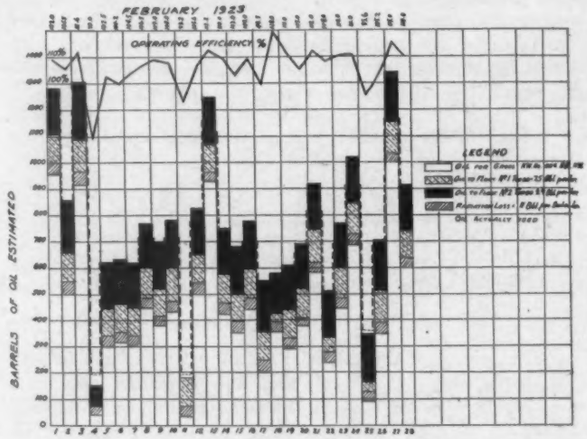


Chart showing actual operating efficiency, described in the text as Sheet 2.

Once the standard curves shown in sheet 1 are plotted for the given conditions no further computations are necessary, as daily results for any load or hours run of any unit can be transferred to the curve sheet by use of a pair of dividers, as shown in sheet 2, it being only necessary to calculate the percentage of actual to estimated barrels to plot the efficiency curve. When the different quantities are blocked off for each day as shown it also makes it easy to determine their relative importance and obtain a clearer idea of the ratio of useful to wasted fuel.

Station Instruments

Nearly all plants on the Coast are using flow meters for various purposes. In a number of cases meters indicating only the flow of steam are use as a guide in properly proportioning the load between boilers for indicating steam consumption on turbines and for indicating steam used for atomizing oil fuel. These are of little value except as they are made valuable by intelligent use by the operating force, as no record is left for future reference or comparison, and there is no means of determining the total consumption or output of various apparatus.

As these instruments are made recording, so that a record is left of the performance of machines, apparatus and men, their value becomes greatly enhanced.

Integrators on these instruments are in limited use, although in many instances they were originally furnished with the meters, but were removed because of unreliability under the conditions of operation.

As a great number of records are simultaneously made on one chart, the value of the records so made become greater, provided, of course, that these pertain to conditions of definite relationship.

Boiler meters recording simultaneous records of steam flow, air flow and flue gas temperature are in very common use and are of a considerable value, both for economy of operation and for checking condition of apparatus, output of boilers, plant consumption, etc.

Steam flow meters recording only the flow are of no great value for accurate determination of superheated steam

unless supplemented by recording pressure gage and recording thermometer, both placed in the immediate vicinity in the steam line with the flow meter connections.

The use of pitot tubes in connection with flow meters has become obsolete, giving way to the flow nozzle in some cases and to the thin plate orifice in others. The thin plate orifice seems to have the preference over the flow nozzle, due to the greater ease of installation and care.

Flow meters working on this plate orifice follow very closely the laws governing the venturi tube and are, therefore, much more easily calibrated.

Venturi meters are in use in a number of plants for measuring condensate and for measuring feed water. In at least one case the venturi meter is used for measuring oil to the boiler furnaces. One plant uses one venturi meter for interconnecting to condensate lines on a number of units.

The value of recording thermometers on steam and exhaust lines is not generally appreciated. They are of more value in the determination of energy distribution than any other class of instrument except, of course, the pressure gages. There is nothing that will give as accurate information regarding absolute back pressure in exhaust lines as the temperature of the dry saturated steam therein. As a check on condensing and vacuum apparatus it has no equal.

There seems to be a general impression that CO_2 recorders are, as a rule, unreliable and inaccurate, not sufficiently rugged to withstand the wear and tear of general use. The Mono Duplex CO_2 recorder seems to be quite reliable and accurate, requiring the minimum of care.

This instrument gives all the useful information that could be given by an Orsat if in constant use by a skilled operator. Omitting the human element, as it does, it becomes invaluable in boiler-room economy.

Referring back to Bailey boiler meters and the method of adjusting air flow to steam flow, so long as the Orsat is taken as a basis for this adjustment the question naturally arises: Why not keep an automatic Orsat at work on the boiler furnaces?

The general use of chemical rather than electrical instruments seems to be the practice for condenser leakage, except in plants using sea water for cooling purposes, where in most cases it has been found that the quicker and more convenient electrical instrument is the rule. The use of recording instruments for this purpose has apparently not become the practice yet, though there seems to be considerable to recommend it.

Careful use of the chemical process of detecting soluble salts in water will enable determination of percentages of make up condenser leakage, boiler concentration and numerous other quantities it is desirable to know.

The following is suggested as a very complete installation for a plant of moderate size, smaller plants avoiding those whose value would not seem to justify the expense of installation:

Boiler Room Instruments
(Not including indicating gages in common use.)

For each boiler—
- (1) Ellison draft gage.
- (2) Bailey boiler meter.
- (3) Venturi tube in feed line with connections so arranged that it can be cut in on a central meter serving not more than four boilers.
- (4) Fuel measuring device for complete check on fuel to each boiler.
- (5) Recording thermometer in boiler outlet.

For each four boilers—
- (1) Venturi meter for use on individual feed lines as mentioned above (3).
- (2) Mono Duplex CO_2 recorder.

For each unit of boilers—
- (1) Recording steam pressure gage.
- (2) Low range indicating gage, for master gage.

Engine Room Instruments

For each main unit—
- (1) Flow meter showing steam flow, pressure and temperature records.
- (2) Recording thermometer showing temperature of exhaust.
- (3) Recording vacuum gage.
- (4) Mercury vacuum gage as check on (3).
- (5) Bi-record recording thermometer on circulating water inlet and outlet.
- (6) Venturi tube and meter circulating water discharge line.
- (7) Indicating thermometer in hot-well line.

For each unit of auxiliary apparatus—
- (1) Steam flow meter with pressure and temperature records.
- (2) Recording thermometer in auxiliary exhaust line.

For water measurement—
- (1) Cochrane V-notch meter showing simultaneous temperature record in connection with feed water heater.
- (2) Neptune or similar meter on make-up. (This meter should be of sufficient capacity to measure entire consumption of plant, as this may be the only source of supply to boilers in case of sudden drop in load.)

The above instruments would give all necessary data for working out a complete heat balance for entire plant. They would also give sufficient check on condenser performance, leakage, etc.

Condensers

The chief source of trouble in steam condensers on the Pacific Coast seem to be tube pitting and corrosion and ferrule leakage.

It is quite generally considered that coarse crystalline structure of the metal is an evidence of conditions which promote corrosion and certain tube manufacturers are prepared to furnish tubes with a grain structure having crystals not exceeding .02 to .03 millimeter in diameter.

We have not obtained any data upon actual experience with such special tubes, but have found extremely rapid corrosion in cases where the structure was very coarse.

All kinds of packing has been used in the past in the effort to obtain a tight gland without excessive seizing of the tube. Of recent years metallic packing has given good satisfaction after the peculiarities of installing it were understood. In some cases light fibre rings have been put in ahead of the packing to eliminate the tendency of the packing to squeeze through between the tube and tube sheet. The practice of omitting ferrules when using metallic packing is still in the experimental stage. An advantage claimed for this packing is the electrical bonding of tube and sheet, which should tend to reduce corrosion. There is a type of corrosion which attacks the entrance end of the tubes and is probably an erosion due to the turbulent state of the water. Partial remedies have been found in painting, tinning or otherwise applying a protective coating to the first six inches or so of the tube. Paint offers the advantage that it can be applied and renewed without removing the tubes from the condenser.

Attention may be called to an experience with large condensers where tube sheets were found, after some years of service, to be cracked around the edges, apparently caused by expansion and contraction of the tubes bending the tube sheet back and forth. It is not possible to definitely connect this trouble with any particular kind of packing, as different kinds were in use at different times.

Such information as has been furnished upon natural draft cooling towers indicates that circulating water may be cooled to about the dry bulb temperature, and that the make-up water required is approximately equal to the rate of evaporation from the boilers. The loss from the tower by wind carrying away spray may be in excess of this, but where such spray loss is prevented by louvers the above rule holds. It is advantageous to have the louver slats amply broad. Metal strips placed at right angles to louver boards at their outer edges still further conserve water from being blown away.

The growth of algae in the cooling tower may be controlled by copper sulphate in a dilution of 1 to 4,000,000.

The general practice as to specifications for circulating pumps was found to be that the purchaser specified the flow required and also the delivery and suction heads against which it was to be delivered, thus assuming the uncertainties as to friction heads.

The chairman of the Prime Movers' Committee of last year recommended that special study be given to an Operating Code, and I wish to concur with him in this recommendation for the work of the next year's committee.

ELECTRICAL CONSTRUCTION

By E. Earl Browne
President California State Association of Electrical Contractors and Dealers

IN the accompanying article, the second of a series, Mr. Browne discusses the latest practice in residence wiring, to provide for the maximum number of convenience outlets on different circuits with the minimum of expense, in conformance with latest code and municipal inspection bureau requirements.

THE use of electrical appliances and devices consuming 450 watts or more, and the use of plug clusters screwed into a socket of a fixture wired with No. 16 or smaller wire (each cluster supplying two or more devices), thereby imposing a load of 8 amp. or more on a socket designed for 2.25 amp. and on a wire which is approved by the National Board of Fire Underwriters for 6 amp. in the case of No. 16 and but 3 amp. if the fixture is wired with No. 18 wire, is a common occurrence where adequate outlets are not available. In order to eliminate the use of these devices in this hazardous manner, it has been deemed necessary by the municipal inspection departments of many cities to provide in the following manner for this condition: in the dining room, kitchen, breakfast room, breakfast nook, laundry (or porch used as a laundry), or bathroom, a convenience outlet, if installed, can be connected to a 660-watt, 2-wire lighting circuit, but no additional convenience outlets can be installed on such lighting circuit.

If no convenience outlet is installed in any of the above mentioned locations, it is required that the lighting fixtures in such rooms be wired with No. 14 B. & S. gage (or larger) wire and that all sockets have an approved rating of not less than 660 watts. In all other rooms, if convenience outlets are installed, not more than four shall be installed on any one 660-watt, 2-wire lighting circuit. In computing the load on the circuit, each single outlet shall be rated at not less than 100 watts and each duplex outlet at not less than 200 watts.

Special Convenience Outlet Circuits

As all modern homes have two or more convenience outlets in each room, it became apparent to the inspection departments that special convenience outlet circuits were desirable and could be installed as a separate system from the general ceiling and bracket lighting circuits at no additional expense. The following rule has been devised to meet this condition:

"A total of 8 single or 4 duplex convenience outlets or multiples thereof, regardless of the room in which they are located, may be installed on a 2-wire, 125-volt or less branch of No. 12 B. & S. gage or larger wire, fused not to exceed 20 amp."

In all cases the now standard 6-amp. outlets with concealed contacts, so designed that the cap may be removed without leaving any live parts exposed to accidental contact, are insisted upon. In addition, no screw base receptacle can be installed within 5 ft. of the floor and even in that case if it is within 4 ft. of an ironing board it is considered as being intended for attachment of an electric iron and must be equipped with a standard convenience outlet as above described.

In the dining room, breakfast room, library and other locations where a table is to be placed away from the wall, it is desirable to have a floor outlet. In order to minimize the expense of installation it has been ruled that if these outlets are installed in wood floors that are varnished, waxed or carpeted, a watertight floor box is not necessary. The only special requirement is that the cover plates be of solid metal at least ⅛ in. in thickness.

For the purpose of determining the sizes of service, etc., the following rule is to be followed: The first special convenience outlet circuit is figured as requiring not less than 1,600 watts, but each additional circuit is to be figured as requiring not less than 660 watts. The following is an example of this requirement:

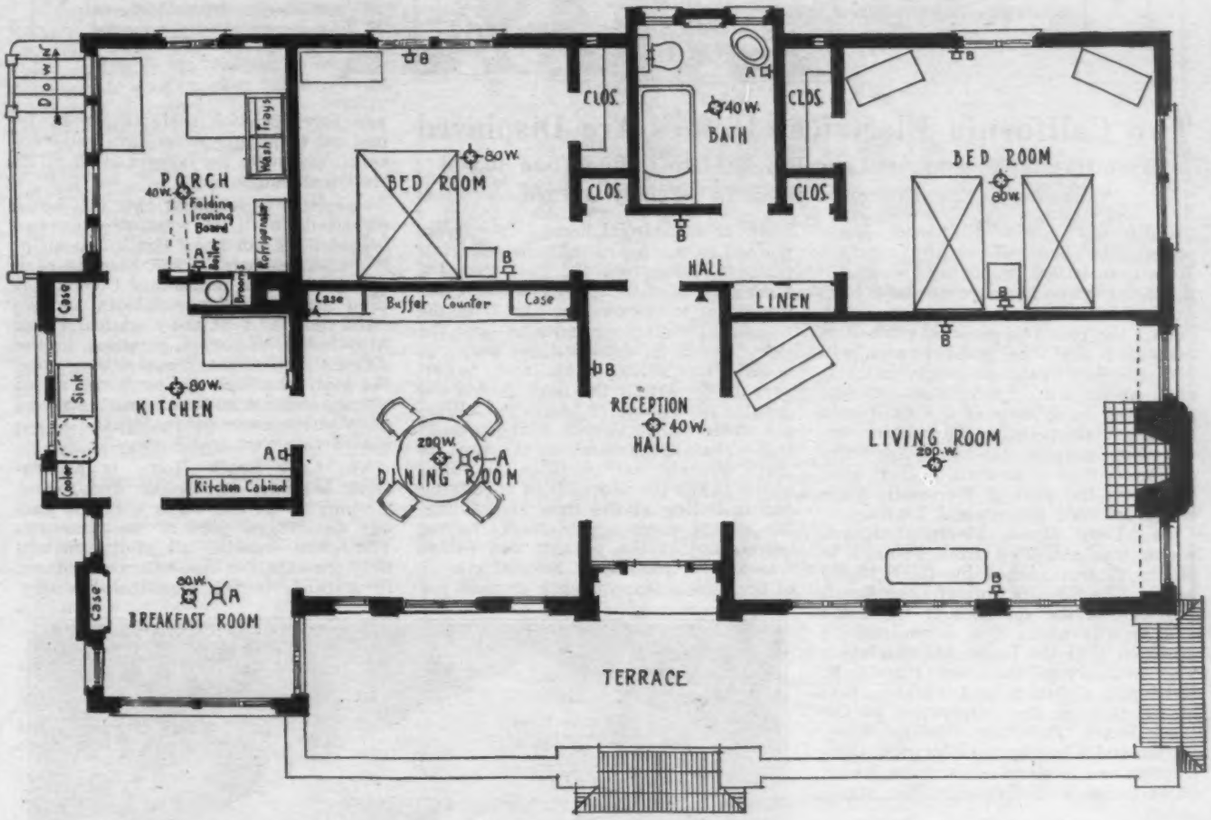
1 convenience circuit	1,600	watts
1 " "	660	"
2 lighting circuits	1,320	"
Total	3,580	"

This would make the service, if 2-wire, No. 8 S.B. Solid R.C. in ¾-in. conduit with a 60-amp., 2-pole switch. If 3-wire, it would be No. 12 wire in ¾-in. conduit with a 30-amp., 3-pole switch. It has also been apparent in many cases that to reduce the cost of electrical installations all outlets were marked as "one electric," which, under the National Electric Code, permitted a total of 16 medium size sockets or lamp receptacles on a 660-watt circuit. After the job had been passed and a certificate of inspection received it was not uncommon to find circuits loaded to 2,000 watts and fused to 20 amp.

A minimum wattage rule has been made to partially overcome this practice. The requirements are that ceiling outlets in the living room, dining room and parlor be estimated as requiring not less than 200 watts; libraries not less than 120 watts; dens, breakfast rooms, kitchens and bedrooms not less than 80 watts; and breakfast nooks and all other locations not less than 40 watts. These ratings apply to the first ceiling outlet in a room. Additional ceiling outlets in the same room may be rated at 40 watts each. If any room is equipped with bracket outlets only, these must be wired for a total wattage at least equal to the above minimums. For example, a living room with two brackets would be rated at 100 watts each.

Where two or more lighting circuits are installed, the load must be divided among them as nearly equally as is practicable. Thus, with a total load of 1,500 watts it is not permissible to load two circuits to 660 watts each and the third to but 180 watts. Each should be loaded to approximately 500 watts.

The various points brought out in the foregoing text are shown on the plan below. No attempt has been made to show a complete wiring diagram. For purposes of simplicity only such outlets are shown as are necessary to explain the text. In case convenience outlets marked "A" are connected to a lighting circuit only one is allowed on each circuit. Those marked "B" are limited to four on each lighting circuit. The minimum wattage for ceiling outlets is also indicated in the various rooms.



The plan above was drawn to illustrate the points brought out in the article. No attempt has been made to depict a complete wiring diagram, only such outlets being shown as are necessary for explaining the text. Convenience outlets marked "A," if connected to a lighting circuit must have but one such outlet on each circuit. Convenience outlets marked "B," if connected to a lighting circuit must have not to exceed four such outlets on each circuit. Each outlet shall be rated at not less than 100 watts if of the single type and 200 watts if of the duplex type.

New Type of Switch Required for Heater Installations

Since the underwriters are now insisting that 3-heat switches for electric heater installations be of the double-pole type, attention is called to the article appearing in the May 1 issue. The type of switch indicated on the drawing on page 334 of that issue was a 20-amp., double-pole, 3-heat flush switch, which to date has not been on the market in commercial quantities. Switches of the double-pole type are now being manufactured and will soon be available in 30-amp. capacity. A 30-amp. switch will require a universal No. 72171 outlet box and a No. 72-C-21 two-gang switch cover as this switch requires a box at least 3 in. deep.

JOBBER, DEALER AND SALES AGENT

Two California Electrical Homes Are Displayed

Exhibitions at Fresno and Long Beach Attract More Than 30,000 Visitors. San Francisco Home Is Officially Opened.

California's 1923 Electrical Home program has been successfully launched. More than 30,000 people were conducted through the two homes which have been exhibited at Fresno and Long Beach during the past two months, while it is estimated that the number who will visit the San Francisco home, which is now open, will approximate 40,000. According to officials of the California Electrical Cooperative Campaign, under whose auspices the homes are being exhibited, never has such interest been shown on the part of the public as is being accorded the present homes.

The Long Beach Electrical Home, which was exhibited from Feb. 22 to March 7, was visited by fully 15,000 people. The Electric Club of Long Beach was one of the sponsors of the home and it was under this organization's direction that the home was displayed. The house was built by Harold E. Ketchum, architect and builder, furnished through the cooperation of the Long Beach Furniture Dealers' Association and wired by the Electrical Contractors and Dealers' Association, which organization also furnished the appliances.

Through the cooperation of the Long Beach papers, a total of 751 in. of publicity was secured for the home. The various agencies concerned with its exhibition used 1,746 in. of advertising in the local papers. All of the advertising carried a cut of the electrical home inviting the public to call and inspect the dwelling. A supply of over 50,000 attractive stuffers giving the details of the exhibition, and inviting the public to inspect it was distributed with the monthly bills of the central station and the telephone company, through the correspondence of all interested dealers and placed in automobiles parked on the main streets. A total of 3,000 window cards inviting the public to visit the home was displayed in hotels, store windows and business houses. Every automobile in any way connected with those interested in the exhibition of the home bore large windshield stickers which carried the invitation "See the Better Home Electrical, 1705 E. First St. Admission Free."

The local representative of the California Electrical Cooperative Campaign appeared before the Board of Education and extended a cordial invitation to the board as a unit and to the entire staff of Home Economics and Domestic Science Departments together with the pupils and classes, to visit at special hours this electrical home. It was explained to the board that the electrical industry recognized the fact that the student body of today will be the homemakers of tomorrow, and that with the wonderful strides and advancement the electric idea is obtaining for usage in home illumination, heat, and power, very likely within the next decade the greater percentage of homes in California would utilize electric heat for cooking. That the present is the time to teach, instruct, and instill in the minds of the pupils the necessity of specifying and installing at the time of building, the wiring necessary to meet the requirements of the present and future was also emphasized. Several classes of domestic science, twenty or more pupils together with their teachers, visited the home on special days and were carefully shown the home and all of its electrical equipment.

Special invitations to visit this home were sent to all the women's clubs and organizations in Long Beach and vicinity, and members of the Electric Club appeared before the Rotary Club, Lions Club and kindred associations and invited them to visit the electrical home. Also invitations were extended to the different merchants' associations and the local Chamber of Commerce, all of whom rendered material assistance and gave public endorsement to the showing of this electrical home.

The Long Beach Home is a two-story building containing five rooms, sleeping porch and bath, with the garage an integral part of the structure. The home embodies all of the modern developments for domestic convenience in addition to the electrical features.

Members of the Long Beach Electric Club paying their official visit to the electric home sponsored by them in their city.

Included in the newer electrical conveniences was the dishwasher, which was built into the drain board of the sink and which was connected to the hot water supply and the sewer. A tumbler switch and a control valve for the hot water were installed in the wall above the dishwasher. The kitchen and laundry attracted the greatest amount of attention from the women visitors.

A feature of the exhibition were the lectures which were given on special days and which were advertised in advance. Experts on various phases of domestic science spoke before large gatherings of women. Prudence Penny, domestic science expert of the Los Angeles Examiner, spoke on "Use of Electric Appliances in the Home and the Necessity of Sufficient Convenience Outlets for the Convenient Use of These Appliances by the Housewife." Milton Hennoch, electric range specialist of the Westinghouse Electric & Manufacturing Company, addressed a large gathering on "The Advantages of Cooking with Electric Heat." Miss B. E. Galvin, head of the domestic science department of the Edison Electric Appliance Company, also discussed this subject. Miss Ione Calkins, domestic science demonstrator, spoke on the various kitchen appliances and especially the electric mixer.

The home contained thirty light outlets, eighteen switch outlets and nineteen convenience outlets, together with service for the electric range and water heater, the electric dishwasher and electric refrigerator. A complete radio installation was another electrical feature which attracted considerable attention.

In checking over the guest register which was maintained for visitors, it was found that the home had been visited by people from England, France, Italy, Norway, Sweden, Japan, China, and various parts of South America.

The home was flood lighted at night to distinguish it from other new buildings in the tract. It was built to serve as a dwelling for the architect and contractor and since its showing an order has been placed for a similar home to be built across the street and the builder announces that he is planning to construct ten more homes in the same tract which are to be completely electrified.

Hostesses were supplied from the district office of the Southern California Edison Company to assist Miss Helen Grahame, the representative of the California Electrical Cooperative Campaign, in exhibiting the home.

Since the exhibition, several builders have approached the Long Beach Electric Club with the proposal that a similar home be displayed in the fall.

The Fresno Electrical Home is one of four modern dwellings comprising a Better Homes Exhibition in the Sierra Vista tract. It was built by Billings & Meyering, sub-dividers and home builders. N. H. Fisher was the architect. Other firms cooperating with the electrical industry were MacRorie-McLaren Company, landscape gardeners, Sherman, Clay & Company, the L. M. Barker Company, furniture dealers, L. S. Cobb & Company, Inc., Maxwell dealer and the local electrical dealers who furnished the appliances. It was displayed from April 12 to 29.

The home is a seven-room dwelling of Spanish design with terra cotta finish. Every modern convenience was included in its construction and when completed, it was known as the "Twentieth Century Exhibition of the Home Complete." The wiring was so complete as to make it practically servantless. Especial attention was paid to ventilation and refrigeration as Fresno is exceedingly warm in the summer. A suction fan was placed in the kitchen and the windows are of the disappearing type so as to afford maximum cooling facilities.

The Home Electrical
An expression of your ideals
THE California Electrical Co-operative Campaign Committee takes pleasure in inviting the people of the Valley to see the model Electrical Home in Sierra Vista. Everyone in the Valley who is interested in greater comfort and convenience in the home will gain worth-while knowledge from this educational electrical exhibit. Every housewife, no matter in what walk of life, may vision in the Electrical Home the freedom which may be hers through electricity. For this is the willing servant of all, rich and poor alike, as economical in the cottage as in the mansion.
We urge you to visit the Electrical Home. It is purely an educational exhibit and demonstration. Admission is free, and nobody will be solicited to buy. In Oakland 70,000 people recently visited a similar electrical home.
The doors of the Valley's first complete Electrical Home are open to welcome you. Will you not come as our guest?
The model Electrical Home will be open to the public April 12 to 29th, inclusive, daily 2 P. M. to 10 P. M. and Sundays 12 noon to 10 P. M. It is located on Iowa avenue near Barton. To get there follow yellow signs out Tulare avenue to First street and out Kercbhoff to 12th, then north to Tulare.
Or take Recreation Park car to Huntington avenue entrance of County Hospital, and walk north to Iowa avenue.
California Electrical Co-operative Campaign
An educational organization representing the four branches of the Electrical Industry in California—Power Companies, Electrical Manufacturers, Electrical Jobbers, and Electrical Contractors and Dealers.

Facsimile of one of the full page advertisements appearing in the Fresno papers during the exhibition of the homes.

In advertising the home, stuffers similar to those employed in Long Beach were used. In the newspaper advertising, all of the various electrical interests pooled their resources and all advertising was done over the signature of the California Electrical Cooperative Campaign. A facsimile of one of the full page newspaper advertisements is reproduced herewith.

Electrical firms of Fresno cooperating in the exposition were the Lewis Electric Company, Valley Electric Supply Company, Central State Electric Company, Fresno Electric Company, Electric Motor Shop, Davison Electric Company, B. A. Goodenough, Robinson Electric Company, Wessel Electric Company, Electric Construction Company, Star Electric Works, J. L. Jones Electrical Works, Independent Electric Company, W-W Electric Shop, and Bellevue Electric Company.

The electrical appliances in each room were as follows:

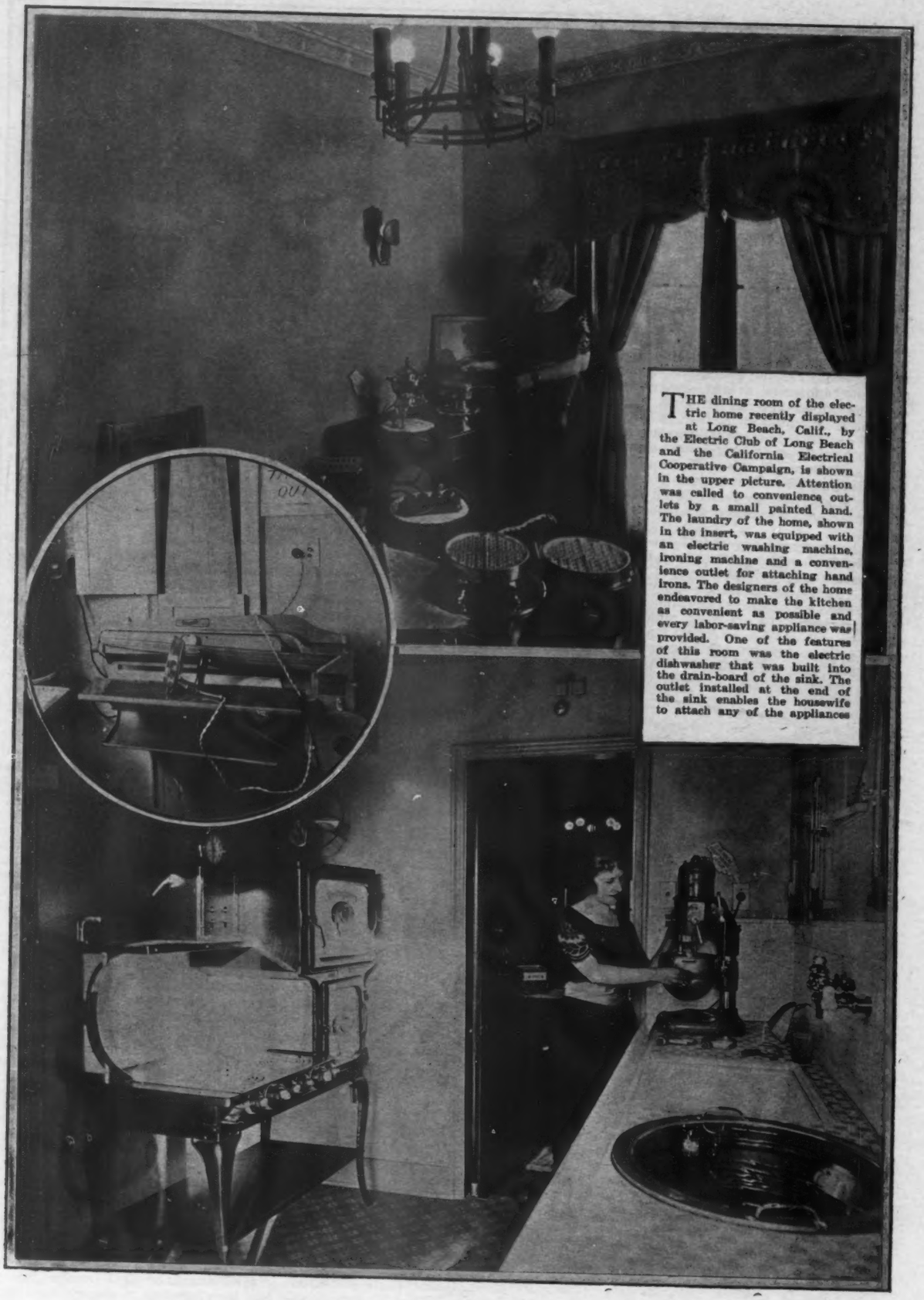
Living room—Electric piano, electric phonograph and portable air heater.

Dining room—Grill, coffee urn set, toaster, tea samovar, electric portable heater and quad receptacle for dining table.

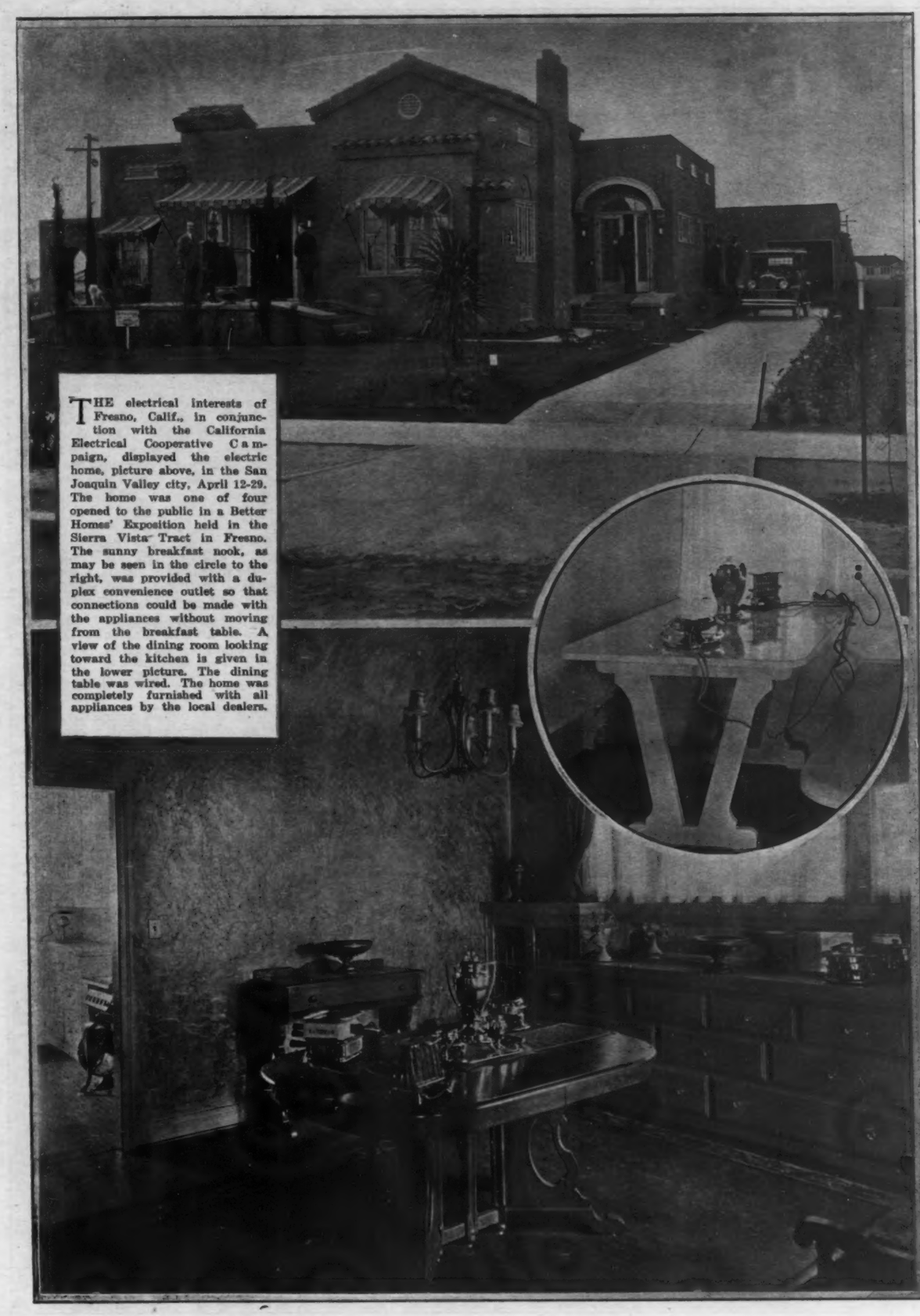
Kitchen—Electric range, mayonnaise or drink mixer, small size dish washer, 10-inch cooling fan and exhaust fan.

A step hitherto overlooked in the displaying of electrical homes was the securing of cooperation from the automobile industry by allowing a dealer to display a car in the garage of the home. This was done in both Fresno and Long Beach and considerable more advertising secured for the home in this manner.

Electrical contractors and dealers in both cities where homes have been displayed announce that public interest has been aroused in electric appliances and better home wiring methods.



THE dining room of the electric home recently displayed at Long Beach, Calif., by the Electric Club of Long Beach and the California Electrical Cooperative Campaign, is shown in the upper picture. Attention was called to convenience outlets by a small painted hand. The laundry of the home, shown in the insert, was equipped with an electric washing machine, ironing machine and a convenience outlet for attaching hand irons. The designers of the home endeavored to make the kitchen as convenient as possible and every labor-saving appliance was provided. One of the features of this room was the electric dishwasher that was built into the drain-board of the sink. The outlet installed at the end of the sink enables the housewife to attach any of the appliances



THE electrical interests of Fresno, Calif., in conjunction with the California Electrical Cooperative Campaign, displayed the electric home, picture above, in the San Joaquin Valley city, April 12-29. The home was one of four opened to the public in a Better Homes' Exposition held in the Sierra Vista Tract in Fresno. The sunny breakfast nook, as may be seen in the circle to the right, was provided with a duplex convenience outlet so that connections could be made with the appliances without moving from the breakfast table. A view of the dining room looking toward the kitchen is given in the lower picture. The dining table was wired. The home was completely furnished with all appliances by the local dealers.

The booth of the Colin B. Kennedy Company, San Francisco manufacturers.

Radio and Electrical Show Held in San Francisco

Success of Initial Exposition Leads Sponsors to Announce that Event Will Be Held Annually on Pacific Coast

Public interest in radio and electrical devices was aroused to a high pitch in San Francisco during the week of April 2 by the First National Radio and Electrical Exposition held in the Civic Auditorium. It is estimated that more than 25,000 people visited the show during the six days it was in progress.

While the primary purpose of the show was to demonstrate the progress which has been made in the radio industry since its inception, the electrical industry capitalized upon the interest of the public by displaying the latest electrical devices and appliances. The San Francisco Electrical Development League played an active part in making the show a success. This organization maintained an information booth and its committees also participated in the arrangement of the programs.

Those electrical firms which displayed appliances were given a rare opportunity of telling the electrical message to the women visitors whose interest was not primarily in radio. At all times electrical demonstrators were surrounded by groups of women whose male escorts were inspecting radio exhibits.

One of the features of the educational exhibits was that maintained by the California State Association of Electrical Contractors and Dealers. In this booth, which is shown in the accompanying illustration, proper and improper methods of wiring a home were shown. The fire hazard of a carelessly installed wiring system was emphasized by means of samples of work which had been taken from burned buildings. Haphazard installations were compared with more modern types and the dangers of the former pointed out. A modern entrance switchboard was shown while below it was a panel of the type which was installed but a few years ago and with which the public is most familiar. Interested spectators were conducted around the booth by J. W. Redpath, secretary of the Contractors and Dealers' Association, who explained each part of the exhibit in detail. The electrical equipment for a modern kitchen was also shown, including range, water heater, air heater, house telephone and some of the various appliances.

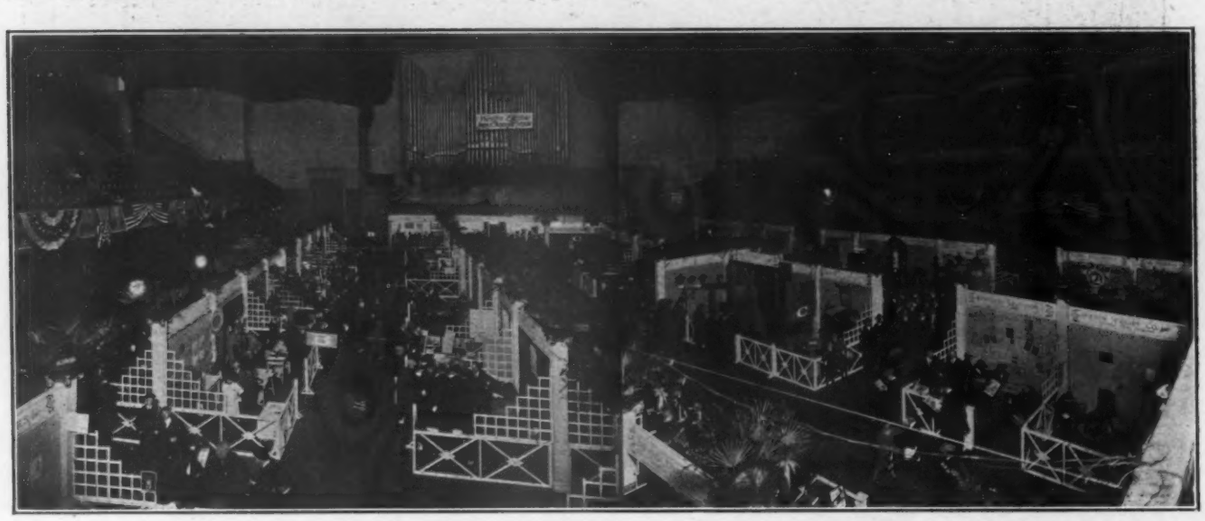
The programs given each afternoon and evening at the exposition were broadcasted by means of a Western Electric public broadcasting system and were heard by radio enthusiasts in all parts of the Pacific Coast region as the system was connected to KPO, the broadcasting station of Hale Bros.

The Pacific Gas & Electric Company displayed the large illuminated map which is a part of that company's road show.

That radio apparatus can be a part of every home was the message that a number of manufacturers of inexpensive instruments sought to tell the visitors. At one place a self-contained radio set, using but a single vacuum tube and dry batteries, was exhibited. The user of this set had but to attach it to an aerial and connect it to the ground, by means of a water pipe, and he could at once receive radio music and entertainment, the demonstrator stated. Another concern, manufacturing locally, exhibited a simplified headset, usually one of the expensive items for the radio fan, which contained but a single pole electro-magnet, wound upon a special core of iron, instead of the usual two-pole or horseshoe electro-magnet. This exhibit was one of the many that attempted to make it easy to understand their apparatus by magnifying it. A huge radio receiver, large enough for an elephant, but still made electrically and mechanically duplicate to the smaller standard instrument, made an interesting and instructive study for both the technical experts and the novices.

Among the unique exhibits was a complete switchboard with a connection between a magneto line and a battery line, a complete line of telephone, telegraph and radio apparatus and an exhibit showing the latest broadcasting equipment, recent improvements in connection with marine telephone apparatus and transoceanic communication.

The marked success of the show has led the company which sponsored it to announce that the exposition will be an annual event in the future.



A general view of the First National Radio and Electrical Exposition held in the San Francisco Civic Auditorium during the week of April 2.

THE booth of the California State Association of Electrical Contractors and Dealers at the Radio and Electrical Exposition, showed the old and the new methods of wiring. The display of the Pacific Gas & Electric Company, shown at right, included a map of the territory served by the utility. The Western Electric Company booth is shown below.

INDUSTRIAL NEWS

Oregon Power Company Starts Transmission Line Work

The California Oregon Power Company of Medford, Ore., has announced to its stockholders that it has started work on a 66,000-volt transmission line in Klamath County, Oregon, running from Algoma north to Chiloquin. Several crews are in the field working on the new line. It is the plan of the company to complete this line during the month of May. The line is to be 20 miles long and is being built to supply power to the Modoc Lumber Company and other industries in Chiloquin.

The company is also to reconstruct its transmission line from Fall Creek Power House to Yreka, Calif. The line to be replaced is the oldest one owned by the power company and was installed in 1903. The new line will be relocated to make the right-of-way more accessible and easier to patrol.

A new transmission line in the Rogue River Division of the company has recently been completed and is ready to serve the Grants Pass Irrigation District and other users along the line. The line extends from Grants Pass to the irrigation district's pumping plants. The district has four pumping plants, aggregating a capacity of 1,050 hp. The new quarry of the Beaver Portland Cement Company at Wilderville, Ore., will also be served by this line.

The completion of this transmission line has necessitated the reconstruction of the Grants Pass substation. This substation has recently been rebuilt and enlarged.

Nelson, B. C., May Sell Power to Florence Mining Company

Subject to ratification by the ratepayers, the City of Nelson, B. C., has entered into a contract to supply the Florence Silver Mining Company with 600 hp. per year for a period of ten years. The Florence company has signed a contract to take not less than $5,000 worth of electricity per year, and as a guarantee of good faith is prepared to deposit $20,000, from which payment for current is to be drawn as the current is used. The mining company agrees to construct a high-tension line from Balfour to the mine, near Ainsworth, a distance of 12 miles, and to turn the line over to Nelson as soon as it is constructed, so that the city may sell power to other mining companies along the route.

Nelson's present power line ends at Willow Point, and in order to fulfill the contract it will be necessary to construct a high-tension line from Willow Point to Balfour, a distance of about ten miles. It is this expenditure that the city council does not feel justified in making without the endorsement of the rate-payers.

At the present time Nelson has extra power and keeps its strings of glow-lamps burning across the city streets during the daytime rather than go to the expense of installing the necessary switches to cut them off. It has developed a hydroelectric plant at upper Bonnington Falls, on the Kootenay River, capable of providing 4000 hp. The capacity of this plant could be increased should the demand for a greater amount of power occur.

The installation in the plant consists of one 750 and one 1-000-kva. Allis-Chalmers three-phase generators, driven directly by two 2,000-hp. Allis-Chalmers turbines. The current is transmitted at 12,000 volts from the powerhouse to Nelson, a distance of 10 miles, over a two-circuit transmission line.

The Florence Silver Mining Company, which has been in operation for many years and has produced a large amount of silver-lead concentrates, has recently been reorganized. Detroit bankers and manufacturers provided $450,000 additional capital to aid in the reorganization.

Government Radio Plant May Be Installed at Salt Lake

The United States War Department is completing plans for the erection of what is to be the second largest army radio station in the country. This station will be erected on the Fort Douglas reservation at Salt Lake City, Utah, if present plans are carried out. Robert Loghry, War Department radio engineer, has been in Salt Lake City and has announced that construction on the new station should start within sixty days.

The station is to be one of three for which construction arrangements have been completed. The government plans to use these three stations in conjunction with smaller relay stations to conduct radio communication from one coast to the other with only a small amount of delay.

According to Mr. Loghry, the new station will operate solely on the continuous wave plan system. It will be designed so that broadcast receivers will not be interrupted by the action of the government plant.

The complaint of the town of Kamas, Utah, that excessive rates are being charged by the Kamas Heat, Light & Power Company has been dismissed by the Public Utilities Commission of Utah. The present rate is 15 cents per kw-hr., with a minimum of $2 per month.

Second Conference Conducted by Columbia Basin League

Nine hundred and eighty-five delegates, coming from three states, assembled at Pasco, Wash., on April 21, at the Second Annual Conference of the Columbia Basin Irrigation League. The attendance this year showed nearly a 100 per cent increase over last year, when 500 men were present.

Large delegations came from the principal cities of the Northwest and the smaller towns sent proportionate numbers. Two of the towns which would receive direct benefit, if the irrigation project is put through, declared civic holidays.

During the meeting speakers expressed confidence in the feasibility of the project of taking water from the Pend Orielle River and delivering it by gravity to the Columbia Basin, where it will be used to irrigate approximately 1,750,000 acres of land. The speakers stated that $200,000,000 of new wealth will be added to the Northwest every year.

According to E. F. Blaine, head of the Seattle delegation and the originator of the plan, no adverse report has ever been made in regard to the project. Major General George Goethals announced in a telegram read at the meeting that the project is feasible and that he is converted to the plan of reclaiming the now dry area. Dr. Hubert Work, secretary of the interior, telegraphed the opinion that he considered the project a very important part of the interior department's reclamation program.

The United States Government's survey of the project will start in the near future. Congress appropriated $100,000 for this purpose.

Among the speakers at the conference were: E. F. Blaine of Seattle, C. F. Stinson and E. J. Reynolds of Pasco, Charles Hebberd, trustee chairman of the league, who read the first year's report; Charles Hurley of Tacoma, president of the organization, who stated that work will be started in four years or sooner; Dan A. Scott, Washington state director of conservation; Dr. E. O. Holland, president of Washington State College; Marshall Dana of Portland, Ore., and N. W. Durham of Spokane, who spoke to dispel the fear of overproduction should the new area be supplied with water.

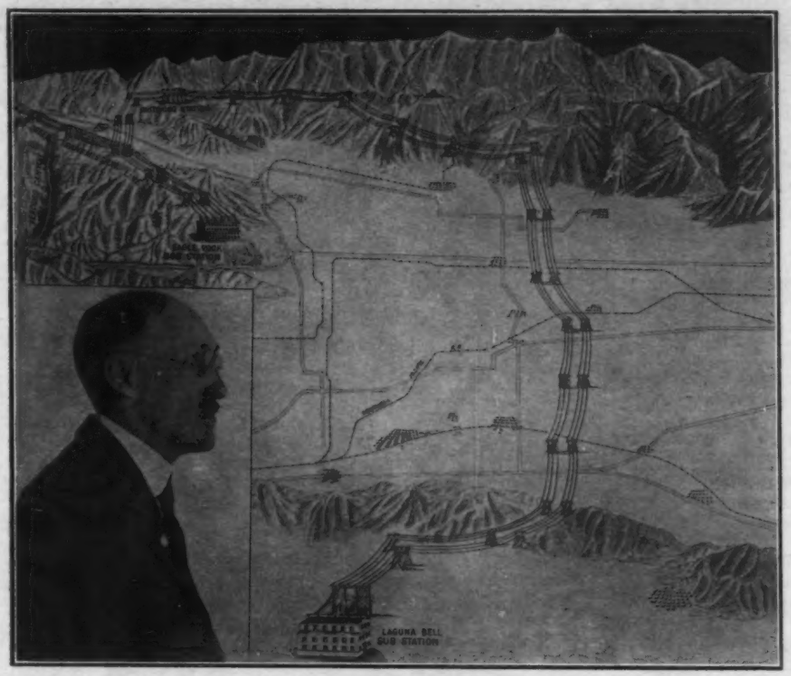
The delegates adopted several resolutions thanking President Harding and tees for the coming year were elected by the group meetings. These men have met and elected officers for the league.

Begin Operating World's Record High Voltage Power Line

Following two years' research work by the engineers of the Southern California Edison Company, and approximately one year's work on the reconstruction of the Big Creek transmission lines for operation at 220,000 volts, the first of the two lines was actually placed in operation at 6:12 a.m., May 6.

The conversion of the Big Creek lines from 150,000 volts to 220,000 volts was brought about by the necessity for additional transmission capacity between the Big Creek water power development and Los Angeles. Operating at 150,000 volts, the Big Creek line as constructed in 1913, had a capacity of 150,000 hp. sion line for that voltage had never been built before and it remained for the engineers of the Edison company to design a line and method for this voltage. Working in conjunction with Prof. Harris J. Ryan, of Stanford University, the Edison company conducted elaborate tests on various combinations of insulators with and without different types of shielding devices.

They found that by placing a metal ring around the insulator next to the conductor, and by adding two insulators to the string, sufficient insulation could be obtained for 220,000 volts. Supplementing these laboratory tests, a 27-mile section of the Big Creek line was taken out of service and equipped with these shield rings. It was energized



Artist's drawing of the route of 220,000-volt transmission line recently put in operation by the Southern California Edison Company. The power line connects the new Laguna Bell Terminal Substation with the Big Creek line which connects the Eagle Rock and Vestal Substations and the Big Creek plant. H. A. Barre, executive engineer of the Edison company, is shown in the insert.

In addition to transmitting energy from the Big Creek developments, the Big Creek lines also, during a part of the year, carry the production from Kern River No. 3 from Vestal to Eagle Rock.

With development on Big Creek at the present time generating 135,000 hp. and the Kern River Plant No. 3 producing 42,000 hp., the lines were loaded to full capacity. As the program of 1923 calls for an additional 22,000 hp. in Big Creek No. 1, and 100,000 hp. in Big Creek No. 3, it was necessary to provide transmission facilities for this additional production, either by constructing a duplicate set of 150,000-volt transmission lines, or by reconstructing the present lines for operation at 220,000 volts. After a comparison of the cost of the two plans it appeared that the lines could be reconstructed for 220,000 volts at approximately $7,000,000 less than the cost of a duplicate set of 150,000-volt lines.

While the electrical manufacturers were willing to construct transformers to operate at 220,000 volts, a transmis-

from Eagle Rock at 280,000 volts and later lowered to 240,000 volts, at which it was kept for about one month. These tests showed that no difficulty might be expected in operating at 220,000 volts. Accordingly a decision was reached to adopt the plan of converting the Big Creek line to 220,000-volt operation.

In making this voltage change many difficulties were encountered. The addition of insulators to the strings so decreased the clearances to ground that in many cases it was necessary to raise the towers. When it came to re-designing the indoor bus structures at the Big Creek power houses and at Eagle Rock, for 220,000 volts, it was found necessary to reconstruct the buildings to get adequate clearances.

This problem was finally solved by installing banks of 150,000 to 220,000-volt auto-transformers at each power house and substation, and not taking 220,000 volts indoors. The auto-transformers are connected solidly in the line. There is one bank for each line, and each bank is capable of carrying the total load of the station to which it is connected. All switching is done on the 150,000-volt side. Each auto-transformer is supplied with a tertiary winding. These are connected in delta to supply a path for any third harmonic present in the voltage wave, thus avoiding high insulation stress which would otherwise exist.

The work of adding additional insulator units to the line and of installing insulator shield rings has been carried along during the past year. Auto-transformers were purchased and installed at power houses No. 1, 2, Vestal and Eagle Rock. No auto-transformers were required for Power House No. 8 since the step-up transformers at this power house were designed for operation at 220,000 volts. With the recent completion of all this work, the West Big Creek line was made ready for cut-over on Saturday night and Sunday morning, May 5 and 6.

The program was planned to carry out the various steps necessary in the most careful manner. The first step was to change the taps on step-up transformers at Power House No. 8 from 150,000 to 220,000 volts. This work was started at 8 p.m. after the peak load of Saturday night. The auto-transformers at the various power houses and substations were also connected to the West Big Creek line. By 5 a.m. Sunday everything was ready to energize the line. Power House No. 8 was connected to the West Big Creek line. The generator at Power House No. 8 with the West Big Creek line connected to it, was slowly brought up until it was generating at 35 cycles. The voltage on the line was then raised to 200,000 volts.

The second step was to transfer the 30,000-kva. condenser at Eagle Rock, which had previously been running on the 150,000-volt line at 50 cycles, to the West Big Creek line. This was accomplished by disconnecting the condenser and permitting it to coast down to the speed of approximately 35 cycles, at which speed it was connected to the Big Creek line.

The third step was to increase the speed of the generator at Big Creek No. 8, at the same time adjusting the excitation to maintain 220,000 volts.

The fourth step was to synchronize at Eagle Rock the West Big Creek line with the East Big Creek line and with the general Edison system.

The fifth step was to parallel at Big Creek No. 2, the East and West lines operating at 150,000 and 220,000 volts, respectively. This system of operating was continued during the following week.

On Saturday and Sunday night, May 12 and 13, the same program was carried out to bring the East Big Creek line into operation at 220,000 volts.

The Pacific Gas & Electric Company has applied to the California State Railroad Commission for permission to execute a contract with the Sierra Pacific Electric Company for the sale of power to the latter company for a ten-year period. The tie-in will be made at one of the plants on the Spaulding system. A minimum of $20,000 worth of energy a year will be bought by the purchasing company during the first five years of the contract.

Hood River Hydroelectric Plant Dedicated on May 10

The new hydroelectric power plant of the Pacific Power & Light Company, located near Hood River, Ore., on the Hood River, was formally dedicated by appropriate exercises on May 10. This plant is the largest of the company's power houses and will cost when completed approximately $1,250,000. It will develop 9,000 hp. At the exercises Lewis A. McArthur, vice-president of the company, was master of ceremonies. A large number of state officials and guests from the other coast power companies were invited to attend.

Contract for Clearing Right of Way Has Been Awarded

Contract for clearing the balance of the right-of-way for the transmission line from West Vancouver to Britannia Beach has been let to J. M. Rolston and H. St. J. Montezambert of Vancouver, B. C. The line is to be built by the British Columbia Electric Railway Company.

The right-of-way is to be 100 ft. wide and the length of the territory to be cleared by the contractors is approximately 23 miles. It is understood that slashing crews will be worked simultaneously from both ends of the line.

The power company plans to follow the clearing crews with construction crews, which will erect poles as quickly as the land is cleared. The contract just placed covers the line between Point Atkinson to Deeks' Gravel Pit, near Britannia Beach. Contract for clearing the right-of-way from West Vancouver to Point Atkinson was let about a month ago.

The line when completed will serve the Britannia Mining & Smelting Company. Contract for about 5,000 hp. of electrical energy was signed by the mining company and the power company last fall.

Construction Work on Columbia Steel Plant Is Started

Actual work on the new plant of the Columbia Steel Corporation at Ironton, Utah, started April 30, when grading contractors set to work excavating for the blast furnace. The Lynch-Cannon Construction Company of Salt Lake City has the contract for grading and excavating and, according to Eugene R. Wheelon, construction engineer in charge of the work, a large crew of men will be used to hasten the completion of the work.

To provide drainage and a sewerage system for the plant site, P. J. Moran, a Salt Lake City contractor, is using a large number of teams to clean an old drainage canal, which will be used for draining the site. The sewer system will be constructed in addition to this canal.

The Koppers Company of Pittsburgh, Pa., has the contract for erecting the by-product coke ovens and is at present constructing an office near the location of the ovens. The industrial tracks of the steel company are now almost completed and the part needed in the construction work will be ready in the near future.

Washington Power Company Orders Large Turbine

Contract for a 2,500-hp. double runner cylindrical-case reaction turbine has recently been let to the Pelton Water Wheel Company of San Francisco, by the Washington Water Power Company of Spokane, Wash. The turbine is to be designed to operate under a head of 80 ft.

The Washington Water Power Company recently acquired the property of the Okanogan Valley Power Company and the former company is now renewing some of the generating equipment of the newly purchased holdings. The new turbine will be installed at the Similkameen River plant of the smaller company, located at Oroville, Wash.

The new unit will resemble, in general design, the Pelton turbine of the same capacity which is now operating at the plant.

That electric energy may be generated and water used for hydraulic sluicing and recovery of placer grain gold, A. M. Truman of Huntington, Utah, has applied to the Utah state engineer for a water diversion permit. Mr. Truman plans to take 10 sec.-ft. of water from Straight Creek in Garfield County. Three sec.-ft. will be used to generate electric power to be used at Camp Rico in the unorganized mining district of Garfield County, and the other 7 sec.-ft. will be used in hydraulic sluicing. The water which will be used to generate electric power will operate 36-in. wheels.

Oregon Men Place Applications to Use Water for Power

A. P. Gardner of Stayton, Ore., has filed an application to appropriate water from the Umpqua River with the Oregon state engineer. He asks for 1500 sec.-ft. for hydroelectric power development. Mr. Gardner plans to erect a power house 147 ft. long, connecting with dam of concrete, and a bulkhead 360 ft. long. Five timber head-gates, 16x14 ft., will be set in concrete gate bulkheads on the upper side of the power house. The project calls for development of 20,270 hp., at a cost of $850,000.

J. G. Kelly of Portland has asked for a permit to appropriate 15 sec.-ft. of water for municipal purposes, including domestic and manufacturing use, from the Clear Lake, Edna Lake and Eel Lake watersheds and the water stored in the Clear Lake reservoir. He plans construction of a concrete gateway, sluice gate and 6 miles of pipe line. The project will cost $100,000.

Electric Club of Seattle Holds Successful Dinner Dance

Members of the electrical industry in Seattle and Tacoma, Wash., put aside all thoughts of business on the night of April 27 and entertained themselves, their wives and lady friends at a dinner dance given at Alderbrook Manor. The purpose of the dinner dance was to get the men of the Electric Club of Seattle and the Electric Club of Tacoma to know each other better.

Approximately 250 persons were present at the resort, which is located about twenty-two miles from Seattle. This number included about thirty contractor-dealers, jobbers and manufacturers' representatives who were delegates from the Electric Club of Tacoma.

The entertainment during the evening consisted of a dinner, which was served at 7 o'clock and followed by dancing. During the evening an excellent opportunity was afforded the men present to make new acquaintances and to renew old ones.

The entertainment committee in charge of the successful affair included: R. M. Cole, Economy Fuse Company, chairman; J. J. Agutter, J. J. Agutter & Company; Fred Block, Pacific States Electric Company; Harry Martin, National Carbon Company; Charles Smutz, Western Electric Company.

Members of the Electric Club of Seattle, the Tacoma Electric Club and the wives and best girls of the members, taken between dances at a recent get-together dinner-dance at Alderbrook Manor, near Seattle.

Night view of the exterior of the first electric home displayed in Loveland Colo., by the owner and the men of the electrical industry.

The home was well supplied with appliances and labor-saving devices, as may be seen in the living room and dining room illustrated above.

Fourth Electric Home Is Displayed in Colorado

Loveland Homeowner Incorporates Complete Electrical Equipment in Home Which Was Visited by 2,300 People

Between 35 and 40 per cent of the entire population of Loveland, Colo., visited the electric home recently exhibited there. The home was open for one week, and during that time 2,300 visitors passed through it and saw how, in the most modern and efficient manner, electricity lightens the housewife's work.

An important feature of the exhibit was the interest taken by the various women's organizations who, through the efforts of Mrs. Anna Duffield, chairman of the woman's department of the Loveland Civic Association, furnished a committee of women for each day the electric home was open to the public. The ladies acted as hostesses.

The house was built by C. A. Williamson as his own home and was designed with a view to making it convenient through the use of electrical labor-savers. Cooperating with the owner were the Western Light & Power Company, the Foster & Kruse Furniture Company of Loveland, which supplied the furniture, rugs, draperies and curtains; the Hines Electric Company, also a local firm, which did the wiring and furnished the fixtures, and various manufacturers of standard electrical appliances.

E. B. Ball, commercial manager of the Western Colorado Light & Power Company at Boulder, Colo., was a strong backer of the local officials of the company.

The display was neatly arranged, with nothing overdrawn. Outlets in walls, baseboards and floors were so arranged as to make for the maximum of comfort and convenience in the use of electric devices pertaining to each room.

The living room contained electric stand and table lamps, electric piano and phonograph and electric glolog fireplace. The dining room was equipped with electric wired table, serving table and sideboard, with outlets conveniently located; electric fountain, toaster, coffee percolator, waffle iron and electric grill.

The kitchen, which was finished all in white, contained a white enamel electric range, a white enamel dish-washer and a white refrigerator, electrically operated. There were also the usual kitchen utensils, such as an electric egg-beater and an electric cake-mixer.

The bedrooms and sleeping porch were equipped with electric heating pads, curling iron, hair-dryer, fan and portable dimmer lamp, while in the bathroom were a room heater and an immersion heater. The laundry, in the basement, contained full laundry equipment, including electric iron, washing machine, drier and mechanical ironer.

Visitors were taken through the home in groups, each group in charge of a demonstrator. There was a total absence of trade talk, the demonstrator instead illustrating the operation and usefulness of appliances and, particularly, in answer to questions, supplying information as to the cost of operating the various devices.

Reports from the electrical contractors and dealers in Loveland show that the display of the home brought about a considerable increase in business in the city. All members of the industry feel highly pleased with the results.

Electric Store of Idaho Power Company in New Location

The Idaho Power Company of Boise, Idaho, recently moved its retail electric store into new quarters at 807 Idaho Street in Boise. The new salesroom gives the company considerably more space and provides a display window 41 ft. wide.

The salesroom has been entirely remodeled for the store and new lighting fixtures have been installed so that the interior may be illuminated correctly. Convenience outlets have been installed throughout the store, so that demonstrations of appliances may be made at any time.

The general offices of the Idaho Power Company and the Boise Valley Traction Company will remain in the Electric Building. Offices of the retail store will be located in the building with the salesroom.

Large Electrification Contract Let by Eastern Railway

The Virginian Railway has recently decided to electrify 213 miles of its railway lying between Roanoke, Va., and Mullens, W. Va. Contract for the electric locomotives, power house transformer stations and other apparatus has been awarded to the Westinghouse Electric & Manufacturing Company. The cost of the electrification will be in the neighborhood of $15,000,000.

The Virginian Railway is electrifying the road to permit it to handle greater quantities of freight. Steam locomotives of the articulated mallet type with twenty driving wheels and four cylinders have been found to lack sufficient power to pull heavy trains over the grades with any speed. Engineers of th railroad have determined that electric locomotives will greatly speed up the handling of freight over the company's tracks.

Industrial activities and community growth in sixteen states of the Middle West, West and South are causing an increase of 39 per cent in the electric power resources of the operated utilities of Standard Gas & Electric Company, according to a new illustrated booklet being distributed by H. M. Byllesby & Company. These companies now supply service to 562,500 customers. Their growth is shown in graphic charts. Air pictures are presented of Minneapolis, St. Paul, Louisville, Oklahoma City, Muskogee, Pueblo, Mobile, Tacoma, Stockton and San Diego.

The British Columbia Electric Railway Company has taken out a building permit for a $45,000 substation, which is to be built on Bodwell road, between Main and Fraser Streets, in Vancouver. The substation, which will be of the automatic type, will serve all street cars in South Vancouver and north of Broadway automatically during the rush hours of the day.

The city council of Logan, Utah, has asked for a $300,000 bond issue to improve the present municipal light plant. A. J. Wiley, engineer of Boise, Idaho, has prepared a report on the needs of the city.

Manufacturing Executives Visit Western Cities

Gerard P. Swope, President of General Electric Company, and E. M. Herr, President of Westinghouse, Make Western Tour

The electrical West has been signally honored during the past two weeks by visits from heads of two of the largest electrical manufacturing concerns in the world, E. M. Herr, president of the Westinghouse Electric & Manufacturing Company, and Gerard P. Swope, president of the General Electric Company. Both executives have visited or will visit practically every large city in the West before their return to eastern manufacturing conters.

Mr. Herr spent several days in Denver, where he received his early training in the electrical industry. He next went to Los Angeles, where he addressed the members of the Los Angeles Electric Club on the business outlook of the electrical industry. While in San Francisco he inspected the work which is being done on the new insulator factory which is being erected by the Westinghouse company in Emeryville. Mr. Herr expressed appreciation of the western spirit in developing and using electricity to the utmost advantage by cooperation of the consumer and power company. He was also impressed by the industrial strides which the West is making.

Mr. Swope, who is accompanied by G. E. Emmons, vice-president in charge of manufacturing of the General Electric Company, came to the Pacific Coast via the Southwest. He spent several days in Los Angeles previous to his visit to San Francisco and then preceded to the Northwest. While in San Francisco he addressed one of the largest meetings ever held by the San Francisco Electrical Development League, discussing the strides which have been made by the electrical industry during the past few years. He also emphasized the growing industrial importance of California.

Mr. Swope also addressed a mass meeting of the Oakland Chamber of Commerce. In that city the General Electric Company for the past 13 years has maintained an incandescent lamp factory with a capacity of 25,000,000 lamps annually. The company has recently completed a $500,000 service shop and high tension switchboard and distribution transformer factory in that city. Both of these plants were inspected by Mr. Swope, in company with Dr. Thomas Addison, Pacific Coast manager of the company, and E. O. Shreve, San Francisco manager.

Annual Meeting of Engineering Council of Utah Held

The third annual banquet of the Engineering Council of Utah was held at the Hotel Utah in Salt Lake City on the evening of April 23.

John Lyle Harrington, president of the American Society of Mechanical Engineers, of St. Louis, who was the principal speaker, told of the origin and development of organized societies of engineers and of recent gigantic accomplishments of members of the profession. He said that the world began to recognize the engineer during the recent war.

Ignorant criticism of the work of the engineer has prevailed throughout history, according to the speaker. The work has been apparently easy, but of recent years a certain "element of mystery has developed about his work, and with its coming a certain respect for the profession has resulted."

The speaker said that scientific work and research are true functions of engineering societies, but that the engineer is learning his obligation of public service today for the first time. "He is beginning to learn that he has a function beyond serving his employer. Too many, high in public service, do as they are told and have not the courage and vigor to demand the right to do what is right," the speaker said, referring to political abuse of the engineering profession.

Hon. William H. King, United States senator from Utah, paid high tribute to the engineering profession, saying that the engineers, "like Atlas, have borne on their broad shoulders the problems of the world." He, too, scored the political abuse of the profession.

Other speakers of the evening were: Congressman E. O. Leatherwood, Percy E. Barber, assistant secretary of the American Institute of Mining Engineers; M. D. Williams, senior highway engineer, bureau of public roads, and H. T. Plumb, former president of the organization.

George H. Dern acted as toastmaster. He called attention to the place engineering fills in civilization. He traced development of all foods, clothing and shelter to the profession. He was introduced by Dr. Joseph F. Merrill, dean of the school of engineering at the University of Utah, who is the new president of the Engineering Council.

Several hundred members of the engineering profession, representing many of its branches, were in attendance. The electrical branch of the profession was particularly well represented.

The Secretary of the Interior has authorized the United States Reclamation Service to contract with the Bucyrus Company of South Milwaukee, Wis., for the purchase of two electric driven shovels at a cost of about $100,000 for use in the McKay dam, Umatilla Irrigation Project, which will cost approximately $2,000,000.

Books and Bulletins

RELATIVITY AND SPACE

By CHARLES P. STEINMETZ, Chief Consulting Engineer, General Electric Company. 130 pages. 6 by 9 in. Illustrated. $7. Published by McGraw-Hill Book Company, Inc., New York.

The renewed public interest in the Einstein theory aroused by the announcement by Professor Campbell of the University of California that one of its predictions—the bending of a light ray by the sun's gravitational field—was confirmed by the photographs of the last eclipse of the sun, makes this volume of timely value. Its purpose is to give a general conception of this mathematical theory and its fascinating deductions in terms that may be understood by a student having a knowledge of algebra and trigonometry. In the reviewer's opinion, this purpose has been achived more clearly and accurately than in any of the other books on the subject yet published. This success is largely due to the fact that the author has such a thorough grasp of mathematics and such unusual ability in expressing his thoughts in understandable form.

The text is arranged as four lectures, which are progressively more specific in statement. The first explains in general terms, by simple physical analogy, that all measurements of motion, space, time and mass are not absolute, but depend upon the condition of observation—the point of view, as it were. Gravitation, like centrifugal force, is shown to be not a real force, but a manifestation of the energy field.

Some of the conclusions drawn from the theory are developed in the second lecture. The old conception of the ether is proven to be contradictory and unnecessary in view of the relativity conception of the energy field. Light and electro magnetism are demonstrated to be not wave motions in the ether, but periodic alternations of energy field in space. Space and time are considered not as independent dimensions, but as part of a four dimensional manifold. The conservation of mass is disproved and mass is shown to be a form of kinetic energy.

The third lecture is devoted to a more rigid analysis of some of these general conclusions. Newton's Law is analyzed as being a first approximation of Einstein's law of gravitation, correct for relatively low velocities. The inadequacy of Euclidian geometry to express the action of centrifugal and gravitational "force" is compared with the more exact statement possible by hyperbolic and elliptic geometry, respectively.

Up to this point the astounding conclusions are reached in an amazingly simple manner. Slightly greater complexity is introduced in the fourth lecture, in which an effort is made to give a conception of the properties of non-Euclidian space in terms of physical space. Stereoscopic pictures are here introduced to good effect, especially in explaining the reason why space may be infinite in terms of Euclidian geometry, but finite in terms of elliptic geometry. The former is shown to apply to space containing no matter, whereas the presence of matter requires elliptic geometry to explain the attendant phenomena.

This brief statement of the revolutionary conclusions reached indicates the contents of this book. It is a text that reveals more with each reading and brings greater conviction as to the soundness of the theory which Steinmetz believes to be "the greatest scientific achievement of the age." The practical value of the theory and of this excellent explanatory text is that it gives a more exact statement and representation of natural phenomena than was possible by the older theories which it replaces. A. H. H.

Meetings

Program Is Announced for June Convention of N. E. L. A.

The convention committees of the National Electric Light Association have recently sent to members of the organization information concerning transportation facilities and an announcement of the business program of the convention to be held in New York City June 4-8. A reduced fare permit entitling members of the association to a round-trip ticket to New York for one and one-half the regular one-way fare has been sent to all members. Men planning to go from the Pacific Coast will find that the regular summer rates set at $147.40 will be cheaper than the rate provided for under the special permit.

The business program for the convention will open the afternoon of June 4, when sessions of the Accounting, Commercial, Public Relations and Technical Sections will be held. The first general and executive session will be held on the morning of June 5. Other sessions will be held mornings of June 6, 7 and 8. The Customer Ownership Committee Session will be held on the afternoon of June 7. The Public Policy Committee Session will be held the evening of June 7.

The Accounting National Section Sessions will be held the afternoons of June 4, 5, 6, 7, as will also the sessions of the Commercial National Section and the Technical National Section. The Public Relations National Section Sessions will be held on the afternoons of the first three days only.

All morning sessions are to start at 9:30 and afternoon sessions will convene at 2:15. Convention headquarters are to be at the Hotel Commomore. Members of the association who plan to attend the convention have been requested to send in their registration and hotel accommodation applications immediately.

Promotional Engineering Work Explained to Engineers

At the regular weekly luncheon of the All Engineers' Club, held at the Commercial Club at Salt Lake City, Utah, on May 7, H. K. Strauss, consulting engineer of Salt Lake City, was the principal speaker. Mr. Strauss spoke on the subject of "Fundamentals in Promotional Engineering Work."

He pointed out that the promotional work on practically any large project of any nature is fundamentally that of the engineer, in the making of reports, studying situations, etc. He stated, however, that the engineer should go a step further and investigate the market for the product before making his report on the feasibility of any project from a commercial standpoint. He others for their aid in the work. Trusshould not limit himself to the physical and mathematical factors alone, the speaker said.

In the discussion which followed Mr. Strauss' talk it was suggested that he follow at a later date with more details on other phases of promotional work of engineers.

Expressions of sympathy contained in a letter written by the Engineering Council of Utah to the widow of Henry W. Adkinson, a prominent mining engineer of Salt Lake City, were read, as were also some of the tributes to his character contained in a newspaper article. Mr. Adkinson's death occurred on May 1.

The meeting was presided over by R. K. Brown, chief engineer of the Salt Lake & Utah Railroad.

New Electric Club Is Organized by Cheyenne, Wyo., Men

Men of the electrical industry in Cheyenne, Wyo., have recently completed the organization of the Cheyenne Electric Club. The association was formed for the purpose of bettering the electrical industry in the Wyoming city. It is the intention of the members to discuss electrical problems and to advise the public in matters pertaining to the electrical industry.

The new club was formed at a dinner held in Cheyenne at which the following men were present: L. C. Phillips, F. W. Fitch, O. L. Moulton, James Cone, T. C. McInerney, C. H. Simpson, George E. Karney, B. U. Young, A. J. Leslie, F. S. Peterson, E. G. Orr, J. R. Padgett, G. M. Brannan, A. C. Jefferis, B. L. Rayor, H. L. Griffin, C. J. Hughes, C. C. Harmon, J. A. Ryan and D. A. LaTorra.

COMING EVENTS

Southwestern Public Service Association—
Annual Convention—Fort Worth, Tex.
May 15-17, 1923

National Electric Light Association—
Annual Convention—New York, N. Y.
June 4-8, 1923

League of the Southwest—
Conference—Santa Barbara, Calif.
June 7-9, 1923

California State Association of Contractors and Dealers—
Annual Meeting—Donner Lake, Calif.
June 9-16, 1923

Pacific Coast Electrical Association—
Annual Convention—San Francisco, Calif.
June 19-22, 1923

Northwest Electric Light and Power Association
Annual Convention—Seattle, Wash.
June 27-30, 1923

Rocky Mountain Division, N.E.L.A.—
Annual Convention—Glenwood Springs, Colo.
Sept. 17-19, 1923

American Institute of Electrical Engineers—
Pacific Coast Convention—Del Monte, Calif.
Oct. 2-5, 1923

Hetch Hetchy Plant Generators Shipped by Manufacturer

Generators for the Moccasin Creek Power House of the City of San Francisco have been shipped from the factory of the General Electric Company at Schnectady, N .Y. Four units of 20,000-kw. capacity each are to be installed in the municipally owned power house.

The power house, which will house the generating equipment, will be of steel and reinforced concrete. It is planned to have the plant in operation within eighteen months.

Edison Lamp Works Advertising Described to Utah Men

T. J. McManis, manager, department of publicity, Edison Lamp Works of the General Electric Company, was a Salt Lake City, Utah, visitor on April 20 and 21. On the evening of April 20 a dinner was given by the Salt Lake branch of the Edison Lamp Works, at which Mr. McManis was the principal speaker.

Mr. McManis told at this meeting of some of the advertising activities of his company. He spoke of the great field ahead of the electrical industry for the development of business and of the important part which he considered advertising would take in getting this business.

Mr. McManis called attention to the fact that there are now, throughout the United States, five million unwired homes within reach of electric service lines. He gave instances of wonderful results accomplished through magazine advertising, citing several well-known concerns whose business had increased tremendously through this form of advertising.

A large number of Salt Lake City electrical dealers and central station representatives were present and a general discussion, devoted largely to some of the problems of the local lamp dealers, followed Mr. McManis' talk. Ernest L. Dee, who has charge of the intermountain territory for the Edison Lamp Works, presided at the dinner and introduced Mr. McManis.

Convention Held in Los Angeles by Mechanical Engineers

Approximately 200 engineers, many of them from eastern manufacturing centers, assembled in Los Angeles at the three-day regional conference held by the American Society of Mechanical Engineers there April 16-18. The visiting engineers were given an opportunity to hear of the electrical development of the West at the technical sessions of the society held on the mornings of April 16 and 17. Several side trips supplemented the papers that were read.

H. A. Barre, executive engineer of the Southern California Edison Company, presented a paper on the hydroelectric development of his company on the San Joaquin River. J. L. Harrington, president of the society, addressed the meeting, telling of the unusual opportunities of the engineer. Other speakers presented papers on mechanical topics.

On the evening of April 18 a formal banquet was held at the Hotel Alexandria, at which John A. Britton, vice-president and general manager of the Pacific Gas & Electric Company, acted as toastmaster. Men high in the society were speakers at the banquet.

Electric vehicle representatives in Los Angeles were the guests of the Electric Storage Battery Company at a dinner on the evening of April 30. H. M. Beck, chief engineer of the operating department of the company, spoke on "Charging and Maintenance of Motive Power Storage Batteries." The dinner at which the men assembled was given at the University Club under the direction of L. F. Boerner, Los Angeles representative of the company.

Personals

G. B. McNair, who is well known in the electrical industry in the Intermountain district, has been appointed district illuminating sales engineer for the Denver territory of the Westinghouse Electric & Manufacturing Company. Mr. McNair has had wide experience in the electrical field, much of his time having been devoted to lighting and kindred subjects. After graduating from Purdue University in 1908 he was first a draftsman for a consulting engineer, later going to the Wagner Electric Corporation of St. Louis as sales engineer. It has been said that all successful salesmen must be good teachers, for they must be able to make the prospect see the picture as the salesman sees it, so Mr. McNair next became a college professor in electrical engineering, at the same time doing commercial research work for manufacturers of lighting apparatus, largely in the gas field. The lure of commercial work was too strong, however, and in 1918 he joined the ranks of the Western Electric Company of Denver as lighting specialist, where he remained till recently, when he was appointed district illuminating sales engineer for the Westinghouse company. Mr. McNair will devote most of his time to street lighting and his services will be available to any municipality interested in this type of civic improvement.

G. B. McNAIR

Roy H. Skill has been named district manager for the Pacific Power & Light Company at Pomeroy, Wash. Mr. Skill entered the employ of the company in 1917 and worked in the Hood River and White Salmon districts in various capacities. He was later transferred to Dayton as lineman, coming from that district to Pomeroy.

G. F. Challoner, head of the financial and sales departments of the China General Edison Electric Company and the International Electric Company of Shanghai, recently arrived in San Francisco from the Orient. Mr. Challoner reports that the outlook for electric business in China was never brighter than at the present time.

Gerard Swope, president of the General Electric Company, visited Denver May 28-29 and was entertained by the electrical and utility men of that city through the Electrical Cooperative League and the Rocky Mountain Committee on Public Utility Information.

Herbert R. Butz, president of the Birtman Electric Company, Chicago, is making an extensive tour of the eight sales districts of the Pacific Coast territory which are under the direction of H. J. Gute. Mr. Butz expresses himself as being highly impressed with the market opportunities in this territory for all classes of electric appliances.

A. M. Jackson, Rocky Mountain district representative for the Locke Insulator Company, with headquarters in Salt Lake City, has been transferred to the Chicago office of the company. Mr. Jackson, it will be remembered, was general chairman of the Electrical Exposition held in Salt Lake City last fall.

A. L. McCarthy, vice-president and general manager of the Eureka Vacuum Cleaner Company, addressed the members of the Los Angeles Electric Club at a recent meeting of that organization on the subject of "Vacuum Cleaner Sales." Mr. McCarthy is making a tour of the Pacific Coast region in the interests of his company.

Dr. Edward P. Hyde, who organized the Nela Research Laboratories of the National Lamp Works in 1908 and who for the past few years has occupied the position of director of research for this department of the General Electric Company, has tendered his resignation to take effect June 30, 1923. Dr. Hyde, who has been active in scientific and technical affairs for many years, has decided to take a long rest abroad. He will retain his office as president of the International Commission on Illumination until the plenary meeting of that organization in this country in 1924.

Willis T. Batcheller, Seattle consulting engineer, addressed the April meeting of the Seattle Section of the American Institute of Engineers on the subject of "The Columbia River Project." Mr. Batcheller spent seven months making an exhaustive survey for the State of Washington in conjunction with the United States Reclamation Service, on the feasibility and possibility of reclaiming the large tracts of land in the Columbia River basin and at the same time developing large blocks of power for industrial use.

Carl Whitmore, division superintendent of plants at Portland, Ore., for the Pacific Telephone & Telegraph Company, has been made division superintendent of installations for the Western Electric Company with headquarters in San Francisco. Mr. Whitmore was a member of the class of 1908 at the University of California.

George E. Baxter has been made traffic superintendent of the Pacific Coast division of the Radio Corporation of America. Mr. Baxter, who began his radio career as a ship wireless operator, was in charge of the Hillcrest Station at Daly City, Calif., for three years prior to the outbreak of the war when he entered the navy. In his new position he will have charge of all radio work of the corporation on the trans-Pacific circuit, including Hawaii and Japan and also all marine traffic. He will direct the operations of the new station just completed at Los Angeles.

James J. Foreman, veteran employe of the Pacific Power & Light Company at Sunnyside, Wash., has been appointed to take charge of the dam and headworks at the recently completed $1,500,000 Hood River hydroelectric plant. **Edward Fewel,** who has been with the company for 20 years, has been appointed chief operator of the plant.

H. B. Squires, president and manager of H. B. Squires Company of San Francisco, with an office in Los Angeles, spent several days in the latter city recently making a survey of local business conditions.

E. M. Herr, president of the Westinghouse Electric and Manufacturing Company, East Pittsburg, Pa., was a recent Los Angeles visitor. Mr. Herr is on a tour of inspection of all the Pacific Coast district offices of his company and remained only a few days in Los Angeles, but while there found time to deliver an address before the local Electric Club on manufacturing conditions in the electrical industry and the trade relations existing with the Orient.

J. B. Pomeroy, western representative for the Rome Wire Company, with headquarters in Los Angeles, is a recent San Francisco visitor.

J. O. Case, formerly local sales manager of the Los Angeles office of the General Electric Company, has just been appointed assistant local manager of that office. Mr. Case has had a very interesting career with the General Electric Company and is one of the most popular executives in the electrical industry in southern California. He graduated from Throop Institute of Technology, now California Institute of Technology, in 1902. In 1905 he went to Schnectady, where he took the student's apprentice course as offered by the General Electric Company at its main works and has been with the company since that time. Mr. Case was local sales manager of the Los Angeles office for two years prior to his present appointment and for eight years prior to that time was manager of the supply department of the local office. Mr. Case is an active member of the Electric Club of Los Angeles, being a member of the executive committee for the present term; he was secretary-treasurer for the year 1922-1923 and for the year 1921-1922 was a member of the executive committee.

J. O. CASE

L. A. Blackburn, formerly with the Erner Electric Company, jobbers of Cleveland, Ohio, and more recently with the Electric Railway & Manufacturers' Supply Company of San Francisco, has joined the merchandising division of the San Francisco office of the Westinghouse Electric & Manufacturing Company. Mr. Blackburn will cooperate with the electrical dealers in the East Bay and Sacarmento Valley districts.

M. H. Henock, formerly with the Electric Railway & Manufacturers' Supply Company, has joined the San Francisco office of the Westinghouse Electric & Manufacturing Company as range specialist.

H. W. Allen, sales manager, Graham-Reynolds Electric Company, Los Angeles, has just recently completed an extensive business trip to all of the cities in the southern California territory, making a survey of the electrical business in the interest of his firm.

H. S. Bastian, assistant engineer of the Portland Railway, Light & Power Company, has resigned to take charge of the new Portland district office of Charles C. Moore & Company. He received his technical training at Bucknell University, Pa., where he received B. S. and E. E. degrees. Leaving the East he entered the employ of the Southern Pacific Company at San Francisco, where one year was spent as draftsman in the signal department. The following four years were spent in Portland as chief draftsman and field engineer in the signal department of the Oregon-Washington Railroad & Navigation Company, a part of the Union Pacific System, where his time was devoted to the solution of electrical and mechanical problems involving signal systems, pumping plants, signal power plants, etc. For a year before entering the employ of the Portland Railway, Light & Power Company Mr. Bastian was engaged in private practice, chiefly mechanical and power plant work. In 1919 he became assistant engineer of the power company, and in 1921 assistant construction engineer in charge of the steam plant efficiency work, in which capacity he continued until leaving recently to take up his new duties with Charles C. Moore & Company. One of his first tasks in his new office will be in connection with the new Long-Bell Lumber Company plant at Longview, Wash.

H. S. BASTIAN

J. M. Curtin, manager of the industrial department of the Westinghouse Electric & Manufacturing Company, East Pittsburg, Pa., is a recent Pacific Coast visitor.

H. H. Argabrite, telephone department manager of the Western Electric Company in Denver, is a candidate for councilman at the city election which will be held there shortly.

W. B. Sawyer, Jr., of the United States Steel Products Company; **H. F. Yost,** Pacific Coast manager of the Trumbull Electric and Manufacturing Company, and **A. W. Copley,** special representative of the Westinghouse Electric & Manufacturing Company, all of San Francisco, were recent Los Angeles visitors and were guests at the Electric Club luncheon during their stay.

J. M. Barry, former chief of the department of electricity of the city of San Francisco, and later distribution engineer for the Great Western Power Company, has been made division manager of the Southern Division of the Alabama Power Company, with headquarters at Montgomery. Mr. Barry was formerly assistant chief engineer of the company, engaged in the construction of the Mitchell Dam project.

John E. Loiseau, for the past eight years secretary of the Montgomery Development & Water Power Company of Montgomery, Ala., has been appointed to the office of secretary of the Denver Gas & Electric Light Company, to succeed **C. N. Stannard,** who was made vice-president and general manager some time ago. Mr. Loiseau has been connected with the Doherty interests for a number of years. Before going to Alabama he was with public utilities in Ohio.

Bertrand Smith of Elk River, Idaho, is now connected with the Seattle office of the Westinghouse Electric & Manufacturing Company as outside engineer of the service department.

Harry L. Harper, Los Angeles district manager of the Western Electric Company, is a recent San Francisco visitor.

E. B. Criddle, general agent of the Southern Sierras Power Company, who has recently been named vice-president of the utility, is a recent San Francisco visitor.

H. M. Byllesby, president of H. M. Byllesby and Company, Chicago, recently inspected the Pacific Coast utilities operated by that company. He spent several days in Stockton, where he visited the American River development of the Western States Gas & Electric Company.

J. B. Tuberger, Pacific Coast manager of the Eureka Vacuum Cleaner Company, spent several days in Los Angeles conducting a sales campaign in connection with E. M. Harvey, sales manager, Woodill and Hulse, local electrical jobbers, and their distributors in this section.

Hobart D. Betts, vice-president and treasurer, Thomas and Betts, New York, manufacturers of conduit fittings, connectors, etc., recently spent several days in Los Angeles and southern California going over this territory with their local representatives, the H. B. Squires Company. Mr. Betts is on a tour of inspection of Pacific Coast cities and expects to visit all the principal cities on the coast before returning to New York.

Obituary

Rex C. Starr, noted Pacific Coast engineer, was found dead on May 3 in the Lake Yosemite-LeGrand Canal of the Merced (Calif.) Irrigation district. All of the circumstances concerning Mr. Starr's death are not known, but a note found with his hat and coat on the bank of the canal leads to the belief that he took his own life while suffering from a nervous breakdown. He was chief engineer and executive head of the Merced Irrigation District, which had just completed the canal; a member of the firm of Thebo, Starr & Anderton, construction engineers of San Francisco, and consulting engineer for the San Joaquin Light & Power Corporation. Mr. Starr had been connected with many important power developments on the Pacific Coast during recent years. After being graduated from the University of Michigan in 1907, he practiced for a time in Detroit, coming West in 1909. For some time he was associated with Stone & Webster in Seattle, holding the position of resident engineer on the construction of the 10,000-kw. Snoqualmie Falls plant and later on the White River plant of the Puget Sound Power & Light Company. He acted as assistant superintendent of construction on the Big Creek project of the Pacific Light & Power Corporation and later held the position of hydraulic engineer with that company, and later with the Southern California Edison Company. Mr. Starr spent another brief interval with Stone & Webster as superintendent of construction on projects in the Northwest, and in April, 1919, accepted a position as chief engineer with the San Joaquin Light & Power Corporation, where he directed the Kerckhoff and Kern Canyon power projects, being retained as consulting engineer by that company when he accepted a position with the Merced Irrigation District a year ago. Mr. Starr was 38 years of age. His tragic death was a great blow to the engineering fraternity.

REX C. STARR

C. B. McDonnell, for the past five years district sales manager at Victoria for the British Columbia Telephone Company, died at St. Joseph's Hospital, Victoria, April 30, 1923.

Manufacturer, Dealer and Jobber Activities

The Johns-Pratt Company of Hartford, Conn., manufacturers of Noark fuses, meter service and protective devices, cutout bases, fuse accessories, vulcabeston packing and insulating parts, and Johns-Pratt molded insulation, have established an export division with office at 30 Church Street, New York City. E. Wilhelm Droosten and W. L. Urquhart, who have had extensive experience in handling export business of electrical manufacturers, will be in charge of this division.

The Whitmore Electric Company, recently organized as a manufacturers' representative and succeeding the Lallie-Whitmore Company, 1637 Court Place, Denver, Colo., has announced representation of the following lines in the Rocky Mountain region: Sweeper-Vac Manufacturing Company, Grinnell Washington Machine Company, Moe-Bridges Company, Hart & Hegeman, and the Domestic Motors Company. R. F. Whitmore is the general manager.

The Master Lighting & Fixture Company, Auburn, Wash., has been incorporated for $40,000 by F. T. Jenks, A. F. Netzel, C. C. Hayes and A. F. Anderson.

The Northwest Washer Company, 213 Pine Street, Seattle, Wash., an exclusive washing machine store, has been opened by Russell Brooks, formerly of Des Moines, Iowa.

The Cheney Light & Power Company, Cheney, Wash., has been awarded contract for electric work on the proposed new dormitory for men at the Washington State Normal School.

The Lapp Insulator Company, Le Roy, N. Y., has recently issued Catalog No. 3. This booklet contains a short treatise upon the manufacture of insulators, giving an idea as to how Lapp insulators are manufactured. The tests given insulators are described. A complete listing of the several types of insulators manufactured by the company is made in the catalog. Diagramatic specifications and illustrations of the insulators are presented. Special porcelain pieces manufactured by the company are illustrated in the catalog.

The General Electric Company recently announced reductions in list prices on substantially all types and sizes of Mazda B and Mazda C lamps. The reductions became effective May 1. The prices will average a general reduction of about 10 per cent. Improvements in manufacturing methods have been assigned as part reasons for the reductions. The desire to enable dealers to get customers into the store for lamp purchases is also given as a reason. The reduction is the third since April, 1922.

The Edison Electric Appliance Company, Chicago, Ill., has recently placed on the market an attachment which when placed on the wafffe iron, made by the company, turns the appliance into a pancake griddle. The pancake attachment fits snugly on the surface of the waffle iron and heats rapidly. The company has also started the manufacture of a new toaster tray.

Schweitzer & Conrad, Inc., manufacturers of high voltage protective and switching equipment of Chicago, Ill., have recently published Bulletin No. 222. The bulletin is entitled "Indoor Equipment." The booklet contains a description of all of the company's forms of high voltage indoor equipment, including fuse mountings, single and double throw disconnecting switches, fused switches and choke coils. Various combinations of these devices are also described and illustrated. The company has also issued Bulletins No. 200, 201, 202 and 204, which deal with fuses, fuse cutouts, high tension equipment and lighting arresters, respectively. The company manufacturers a complete line of these devices.

The Square D Company, Detroit, Mich., has put on the market a new line of switches which embody a radical change in safety switch design. The new switch design provides for separate bases for each line terminal, switch blade and fuse clip. Each of these is mounted on a separate base of molded composition instead of being grouped on a common base of slate. The individual base makes it possible to remove any part from the front of the switch in a few minutes without disturbing the wiring. The new base reduces the weight of the switch about 25 per cent.

Altorfer Brothers Company, Peoria, Ill., recently shipped a consignment of A. B. C. washing machines to A. A. Wilson of Los Angeles, Calif., the retail value of which was $400,000. Forty box cars were used to transport the shipment from the factory at Peoria to Baltimore, Md. From Baltimore the shipment moved by boat through the Panama Canal to Los Angeles harbor. The trainload of washers leaving the Altorfer factory makes the fifth one that the company sent out on single orders.

Announcement has been made to the electrical trade of the Rocky Mountain region by the Mountain Electric Company in Denver, of its removal to 1433 Lawrence Street.

The Atlantic-Pacific Sales Company, San Francisco, Calif., formerly the Atlantic-Pacific Radio Supplies Company, has announced that the change in name was brought about by the change in policy of the company. This company has extended the field which it serves and is now conducting a general jobbing business of electrical equipment. Among the men who have recently joined the sales organization of the company are: E. M. Cutting; A. S. Kedzie, who will handle the Bissell cleaner line; A. E. Carroll, who will be assigned to the line of Rutenber heating appliances; R. J. Noel and G. F. Hall.

A motor driven bell striker has been placed on the market by the Electric Automatic Appliance Company, 1749 Arapahoe St., Denver. The device has two hammers which are thrown out by centrifugal force and will strike on the rim of the bell at each revolution and rebound. P. A. Brown is the inventor.

The Walker Electric Company, one of the principal retail electric supply houses of Salt Lake City, has moved into its new home at 15 East Broadway. The former location of this firm was at 159 South State Street.

The Hendrie & Bolthoff Manufacturing & Supply Company of Denver has been appointed Rocky Mountain distributor of the Royal vacuum cleaner by the P. A. Geier Company of Cleveland. The new arrangements will not conflict with the present exclusive retail representation in Denver by the Denver Dry Goods Company, it is understood. Representation of the Line Materials Company is also announced.

The F. W. Wakefield Brass Company of Vermilion, Ohio, manufacturers of "Red Spot" lighting specialties, recently brought out a ceiling unit which is specially adaptable for kitchens and bath rooms. This addition to the "Red Spot" line is finished in white enamel and is designed for use with any glassware. With 150-watt daylight mazda lamp the unit has proven especially popular and efficient for lighting kitchens.

When this picture of the officers of the Electric Club of Seattle was taken the men whose likenesses are reproduced above were not thinking of volume, sharp pencils nor bank balances. This undoubtedly explains why they all look like "regular fellows." The men are, from left to right, front row: Fred Larkin, director; George Reiniger, vice-president; J. J. Agutter, past president; W. E. Jones, president; S. G. Hepler, director; second row, Frank Cooley, director, and Rush McCarger, secretary.

Trade Outlook

San Francisco

During the month of April the number of building permits issued in San Francisco declined slightly, but the value of the permits increased over those issued in March. Nine hundred and fifty-four permits, for buildings valued at $5,173,801, were issued during April while the value of the buildings covered by the 977 permits issued in March was $3,229,572.

Despite the small drop in the number of permits issued, trading in real estate in the city continued active. Sales were made at prices which tended to be higher than they have been in the past. Building costs continue to remain firm, with a possibility of becoming higher.

Electrical dealers and jobbers have reported that prices are higher than they were at this time last year, in some cases being as much as 20 per cent over last year's list. Business is reported as being fairly active, the continued building program acting as a stimulant to the market. Contracting companies are kept busy on new and repair jobs.

General business conditions reflect activity. A large spring business was had by most industries and retailers are changing their stocks preparing for a steady summer season. Price advances have been reported in textiles and general household furnishings.

Seattle

Strenuous efforts on the part of the I. W. W. organization to call a general strike in the lumber mills and logging camps of the Pacific Northwest has largely failed. Only a small number of workers responded to the call, the men who did being confined almost entirely to the logging camps. Meanwhile, lumber production continues heavy, with practically all the mills cutting in excess of their output a year ago. Mills in the Inland Empire district are, in many instances, operating night shifts to keep up with the demand for lumber products.

Reports from eastern parts of the state indicate that a bumper wheat crop may be expected, and that all crops are in excellent condition. Prices are expected to be sufficient to insure a fair profit for this year's crop, and farmers are encouraged over the present outlook.

Seattle is sharing in the generally better conditions which prevail in building lines, and has a particularly satisfactory labor situation as compared with other localities. All kinds of building work are under way and the residence construction is expected to be unprecedented in the city during the summer.

Electrical dealers and jobbers in Seattle and the Puget Sound district report a very encouraging outlook for the summer. The volume of trade transacted so far this year is said to show a 25 per cent increase over that for last year. Local men are confident that the summer and fall months will show good returns in sales volume.

There is a slightly increasing demand for protective apparatus to guard plant equipment against injury from electrical storms occurring occasionally in the fall and winter months. While these storms are infrequent, the loss sustained is sufficient to warrant protection.

Salt Lake City

With farmers now receiving what they believe is a fair profit on the crops that have been held over from last season, and the excellent planting weather of the past few weeks, the outlook for the farmers for the coming season is very encouraging. Practically all of the wool crop has been sold, and it is estimated that in Utah alone the value of this year's wool crop will be in the neighborhood of $6,500,000.

Mining conditions continue to be exceedingly good, and increased industrial activity is noted throughout this territory.

In Salt Lake City building permits issued during April, 200 in number, represent a large increase over the same month of 1922.

Electrical jobbers report a continued increase in business, with bright prospects for the balance of the year. Contractor-dealers are fairly busy on account of the opening of the building season. Since the drive on washing machines has subsided to a considerable degree, vacuum cleaners have been moving to quite an extent. The coming summer is expected to produce good results in the sale of electric ranges.

There are many indications of money being easier, and the general outlook is very encouraging.

Denver

The upward movement of trade and industry in this district since the beginning of the year, has been sustained during the spring season. The volume of wholesale and retail trade exceeds that of last year. Manufacturing is proceeding at an exceptionally high rate.

Sales of electrical supplies continue to gain, distributors reporting an increase in volume of about 30 per cent since the beginning of the year as compared with the same period in 1922, with an increase of about 20 per cent in dollars and cents. Prices are increasing on large motor equipment and advances on small equipment are expected at any time. Copper in all forms, excepting possibly switches, continues to advance in price.

Increases due to demands for building construction equipment will continue if the present new building program continues without abatement in Denver. Excepting May 1922, the month of April just passed broke all building records. A total of 784 permits were issued with a valuation of $2,225,100, which brought the total value since the first of the year up to $6,437,950 as compared to $4,621,300 for the same period in 1922. April permits exceeded those of the same month last year by nearly a half million dollars.

Portland

The Portland district appears from many strong indications to be well started on a period of great business activity. Reports for April of this year show the following substantial increases over March of this year: bank clearings 19.1 per cent, postal savings 9.6 per cent, building permits 34 per cent. Residence construction continues brisk, being about 50 per cent of the total building.

There is an upward tendency to costs of construction which is undoubtedly affecting the volume to some extent, but the record for the present year is expected to pass that of 1922, which was the highest in the history of the city.

In the lumber industry there is very great activity with mills running extra shift in an endeavor to keep up with orders. Production is about 30 per cent above normal and prices remain firm. Shipments are going to all parts of the country and to foreign countries as well. About 40 per cent of the cut is moving by water.

The wool market is strong and active. It is estimated that 75 per cent of the 1923 Oregon clip has been sold by the growers and at good prices.

Los Angeles

Los Angeles building total for April was $15,352,944, which represented the issuance of 5,094 permits, while for the same period of last year the number of permits issued was 3,983 with a valuation of $12,959,686. This represents an increase of about 20 per cent.

Bank clearings for the month of April amounted to $558,567,539.65, which compares with the same period of 1922 with $400,290,325.60 as an increase of approximately 40 per cent.

Prices of electrical supplies and wiring devices in this section are remaining firm, but the price of conduit and rubber covered wire has increased, while there has also been an increase in some styles of motors.

The Southern California Internal Revenue District, with headquarters in Los Angeles, reports the total of $1,072,588 collected as admission taxes from motion picture theaters, for the first quarter of 1923, as compared to $890,543 for the same period in 1922.

These increases are but representative of the increase and expansion in all lines in Los Angeles and southern California and the electrical industry through the building program is obtaining its fair share of the increase.

The election of May 1, in which a spirited contest was conducted on the part of the electric railway companies as opposed to motor buses, was decided in favor of the electric railway systems.

Construction News

Bridges

Calif., San Francisco—Contract for the construction of the transbay bridge from Coyote Point to Mount Eden has been awarded to the Coast Construction Company of San Francisco. The cost is estimated at $10,000,000. It will be necessary to have plans and specifications approved by the War Department and surveys are under way. Bayley Hipkins is president of the Coast Construction Company.

Ore, Salem—Contract for the construction of a bridge on the Columbia River highway over the Lewis and Clark River between Astoria and Seaside has been awarded to the Pacific Bridge Company of Portland on a bid of $170,000.

Wash., Olympia—State Highway Commission recently awarded contract for reinforced concrete bridge over the Touchet River, on the Inland Empire Highway, between Waitsburg and Dayton, to the Colonial Building Company, Spokane, on their bid of $14,820. Contract for constructing steel bridge and concrete approaches over Koch Slough on the Pacific Highway, near Silvana, Snohomish County, was let to C. C. Snyder Company, Seattle, for $23,228.

Wash., Chehalis—C. L. Graves of Spokane, on a bid of $29,572, received contract for construction of a 220-ft. steel bridge across the Chehalis River near Claquato. His bid provided for wooden stringers.

Wash., Kelso—The Cowlitz County Commissioners will erect a new steel bridge, 200 ft. long, to replace the Manna bridge over the Toutle River, recently condemned.

Wash., Everett—Snohomish County Commissioners have approved plans for the proposed $35,000 bridge to span the Stillaguamish River at Arlington, and plans will be presented to the State Highway Commission for final approval, preparatory to calling for bids.

Highways

Colo., Denver—Contracts for six highway projects in various portions of the state, costing an aggregate of $130,000, were let by the state highway commission, following approval of the projects by Governor William E. Sweet. The contracts are for gravel surfacing, grading and the building of two bridges. The six projects follow: Crushed rock surfacing of three and one-half miles of road in Mount Vernon canon, $34,000. Gravel surfacing of two miles of road between Craig and Meeker in Nine-Mile Canon, $31,000. Gravel surfacing of three miles of road between Kremling and Meeker, $28,000. Grading and drainage of three miles of road east of Coventry in Montrose County, $10,000. Bridge across Box Elder Creek, east of Watkins in Adams County, $15,000. Bridge across Cherry Creek, near Melvin, in Arapahoe County, $15,000.

Idaho, Blackfoot—Bids for the construction of unit B, federal aid road project No. 61, were opened at the offices of the county commissioners, showing Gline & Shaffer low bidders at $23,103.75. Unit B is a 4½-mile stretch of the Yellowstone Highway between Wapello and Firth. It will be built of crushed gravel and will complete the only section of unimproved highway between Blackfoot and Idaho Falls. It is an extension of a 13½-mile contract now under construction by the same contractors. Work is to be completed by Aug. 1.

Wash., Olympia — Contract for grading 8.7 miles of the Olympic Highway, between Agnew and Port Angeles, Clallam County, has been let to K. L. Goulter & Company, Ilwaco, at $181,664.97. Contract for grading 6.9 miles of the Pacific Highway, Bellingham to Ferndale, in Whatcom County, let to John Ottison & Co., Inc., Seattle, on their bid of $67,371. Contract for grading and graveling 4.2 miles of the Sunset Highway in King County, Preston to Falls City, was awarded to Dowell & Clarke, Seattle, for $76,000. Contract for paving 4.85 miles of the Sunset Highway, from Spokane County line to Reardon in Lincoln, was let to C. M. Payne of Spokane for $161,503. All of above contracts awarded by the state highway commission.

Wash., Spokane—Highway improvements totaling $802,000 in North Idaho have been approved as follows: Lolo Pass Highway, 30 miles, $482,000, all government funds; Bonners Ferry Road, 8 miles to Montana line, grade and surface, $105,000; Fourth of July Canyon, 22.4 miles, surfacing, $100,000; Weeksville-Thompson Falls Road, grading, $85,000.

Wash., Seattle—King County commissioners will receive bids until May 28 for grading and graveling of the Coutts Road, estimated to cost $15,000.

Wash., Olympia—Contract for paving 4.47 miles of Pacific Highway in Cowlitz County, Neals to Toledo, was recently let to Goetz & Brennan on their bid of $141,278. Contract for paving 3.07 miles of the Sunset Highway from the Wenatchee bridge north was let to Yakima Paving Company of Tacoma on their bid of $99,435. Contract for clearing, grading, drainage and surfacing with crushed rock of about 6.9 miles of Inland Empire Highway between Colville and Meyers Falls in Stevens County was let to Mitchell Bros. of Spokane on their bid of $43,963.

Wash., Walla Walla—Contract for grading and surfacing with crushed rock of 9.63 miles of Permanent Highway No. 28, Lower Waitsburg Road, was recently let to H. L. Wilson of Walla Walla, on his bid of $52,792.

Wash., Chehalis—Contract for hard-surfacing one and one-half miles of the Lewis River Highway has been awarded to Swanson & Co., Portland, on their bid of $23,000.

Wash., Tacoma—Pierce County has awarded to J. H. Collins, Spokane, contract for paving of 2.8 miles of Permanent Highway No. 19, Wilkeson to Carbonado, on his bid of $62,951.

Irrigation Projects

Mexico, Sonora—Quinton, Code & Hill, consulting engineers, Hollingsworth Building, Los Angeles, Calif., are preparing plans for a diversion dam and irrigation project to be constructed in the State of Sonora, Mexico, by the Richardson Construction Company, as owner, Van Nuys Building, Los Angeles. The dam will be constructed at the junction of the Yaqui and Moctezuma rivers, and will be planned to raise the water 10 ft. This dam will be 3,300 ft. long, 12 ft. high and 125 ft. wide. The structure will be of rock fill with concrete paving on top. The main works will be built on sand and gravel foundation, while the headworks will be on rock base. The project will involve considerable canal construction. The dam and other work will provide irrigation for approximately 600,000 hectares. The approximate cost of the work is $1,000,000. The Southern Pacific is building a branch line connecting with the main line giving rail facilities for construction purposes and an outlet for the land.

Wash., Spokane—The North Spokane Irrigation district has awarded J. C. Broad the contract for labor and water mains required in connection with the development of the project at $51,000. Bonds of $75,000 have been authorized and a portion of this sum will be used for required pumping equipment.

Wash., Vancouver—Bids on the Washougal diking project, the second largest ever attempted in Clarke County, will be called June 1, according to Walter Schwarz, county engineer, who is preparing specifications. Estimated cost of the drainage is $120,000.

Power Projects

Wash., Seattle—Contract for clearing section 14 of the right of way for the 10-mile transmission line from the Gorge Creek Plan of the Skagit project to the city of Seattle has been let to Besoloff & Brice, Seattle, for $38,880.

Wash., Seattle—The supervisor of hydraulics, Marvin Chase, Olympia, has received application from the Superior Portland Cement Company of Seattle for water appropriation for a large hydroelectric power project to be installed on Jackman Creek in King County. Plant will cost approximately $175,000, and a pipe line 2.37 miles long will be built.

Wash., Woodland — The Puget Sound Power & Light Company, which recently purchased the properties of the North Coast Power Company in Vancouver, plans extension of power line from Woodland to Vancouver to supply current to the street car lines, now supplied by the Portland Railway, Light & Power Company.

Railways

Calif., Los Angeles—The engineering department of the Los Angeles Railway Company is preparing plans for a new shop unit to be erected at 54th Street and South Park Avenue. It will be 100x400 ft., brick and steel construction and will cost about $150,000. Plans are also being prepared for a new car barn of similar construction.

Idaho, St. Maries—Fred S. Herrick, St. Maries, Idaho, will construct 80-mile logging railroad, costing $1,000,000, for the purpose of hauling logs from a 67,400-acre tract of land purchased from the government for $4,000,000. Road will be standard gage and 40 miles will be completed during 1923.

Wash., Spokane—Improvement work costing $170,000 is contemplated for this year by the Spokane International Railway. The biggest item will be rebuilding of a tunnel north of Bennero Ferry, which will cost about $75,000. Line work will also be done.

Streets and Sewers

Calif., Huntington Park—At a special election held recently a sewer system was voted on favorably by a large majority. Bonds to the amount of $250,000 are to be sold.

Calif., Pasadena—Work will start at once upon erection of $500,000 sewage disposal works at the City Farm. Eighteen tanks, 275 ft. long, 68 ft. wide and 18 ft. deep, will be built.

Calif., Pasadena—City directors are planning to draw up resolution of intention calling for the construction of the northwest sewer system and for the Linda Vista sewer system and for the outfall sewer to be built in the Arroyo Seco, from Brookside Park to California Street. Cost, $112,000.

Calif., Long Beach—The city council of this city has authorized sewer and storm drain work and paving contracts in the Belmont Shore Place, a subdivision on the eastern end of the city along the beach front. The Two-Miracle Concrete Corporation was awarded the contract, the cost of which will total approximately $480,000. James F. Collins is chief engineer in charge of the Belmont Shore project.

Calif., Long Beach—The Butte Electric Manufacturing Company, Pacific Electric Building, Los Angeles, was awarded the contract at $45,-

548 for constructing an ornamental lighting system on Pine Avenue from Ocean Blvd to 14th Street.

Calif., Long Beach—Butte Electric & Manufacturing Company, 445 Pacific Slectric Building, Los Angeles, has been awarded contracts for constructing ornamental lighting systems in the following streets: Anaheim Street, between Temple and Loma Avenues, at $17,875; Pine Avenue, between Ocean Blvd. and 14th Street, at $45,548.

Utah, Provo—Mullen & Palm have been awarded contract for the paving of Second South Street from University Avenue to First East Street, and the curbing of both sides of First South Street from Fifth West to Fifth East; the east side of Fifth West Street from Center to Third South; Second West Street from Center to First South, and First and Second East Streets from Center to Third South, all of which is designated as Paving District No. 16 and Curb and Gutter District No. 7, respectively. This firm's bid on the street paving was $4075 and $37,518.31 for the curb and gutter.

Wash., Seattle—Contract for paving Findlay Street et al, estimated to cost $37,000, was let to Coluccio & Errickson, 517 22nd Avenue South, Seattle, for $43,030. Paduano & Company, 646 West 51st Street, Seattle, on a bid of $31,532, received contract for concrete sidewalks on Atlantic Street. Contract for paving Union Street with concrete has been let to J. L. Smith, Pioneer Building, for $40,548. Low bid for paving of 24th Avenue North, et al., was submitted by C. L. Creelman at $22,786. Low bid for constructing a tunnel under the Duwamish Waterway on First Avenue South was submitted by R. L. Sparger, Colman Building, at $107,582. The work involves sinking shaft, 137.5 ft.; driving tunnel 400 ft.; shaft lining, 400 cu. yd. concrete; tunnel lining, 500 cu. yd. of concrete. One of the largest improvement districts in Seattle will be formed to meet the expense of a new sewer system for district between Snoqualmie Street on the north and Myrtle Street on the south, in the Duwamish Water district. Work is estimated to cost $300,000.

Wash., Kelso—City council has approved the engineer's estimate of $39,543.14 for paving of Oak, Grade, Third, Fourth, Fifth and Academy street here, and call for bids will be issued shortly.

Wash., Kelso—On a bid of $55,323.02 the United Contracting Company of Portland received the contract for paving Cowlitz Avenue with 2-in. bitulithic on a 4-in. crushed rock base.

Wash., Kelso—Contract for installation of sanitary sewer system for the new town of Longview has been let by the Long-Bell Lumber Company to Bardsen & Company of Butte, Mont. Contract for the storm sewer installation, involving 26,000 cu. yd. of excavation and laying 39,000 lin. ft. of pipe, was let to J. D. Hanley, of Portland. Contract for concrete sidewalks and curbs has been awarded to Bonnell & Savage, of Tacoma. The work will cost $500,000, and is the first unit in the proposed $4,000,000 paving program outlined for the city. This unit involves 180,000 sq. yd. of concrete paving, and several thousand feet of concrete sidewalks.

Wash., Everett—Paving of Pacific Avenue, from Chestnut to Wetmore Avenue, at an estimated cost of $75,000, is proposed by the city council. District includes 14 blocks.

Waterworks

Calif., Alhambra—City commission has decided to submit to city voters a bond proposition amounting to $349,000, comprising the following items: $250,000 for water department extensions and betterments; $75,000 for the fire department; $12,000 for storm protection; and $12,000 for city yards. A resolution of intention to call the bond election has been adopted.

Idaho, Boise—Charles H. Helmer, contractor of Boise, has been awarded the contract for the construction of 30 miles of water system from Sage Springs into Rawlins, Wyoming.

Wash., Kelso and Longview—Construction of a water system for these two cities in Cowlitz County is to begin. The right of the appropriation of the waters of the north and south fork of Goble Creek, a tributary of Cowleman River, has been granted. The project involves an expenditure of approximately $663,000. The main project is that of the south fork, which is to cost $600,000; 7.9 miles of pipe line will be required and the hydraulic fill dam will be 90 ft. high, with a length of 500 ft. on the top and 35 ft. at the bottom. This estimate includes drainage provisions for both projects. The north fork project requires 1.1 miles of pipe line and will take a dam 80 ft. high and 400 ft. long on top and 40 ft. long at the bottom. This cost is estimated at $63,445. Present requirements are estimated at 15 to 30 sec.-ft., and 40 sec.-ft. in the future.

Wash., Odessa—This city has voted $12,000 to pay for the construction of a concrete reservoir to replace present wooden tanks.

Wash., Camas—This city has filed application with the state supervisor of hydraulics asking appropriation of the waters of the Little Washougal River, for establishment of a municipal water system. Plant proposed will cost $156,000, and will require a pipe line 7½ miles long.

Wash., Centralia—The city of Centralia has been granted a permit to divert 7 sec.-ft. of water from Mitchell Creek for the purpose of augmenting the municipal water supply. The construction of a 2-mile pipe line and concrete dam will cost about $30,000.

Miscellaneous

Calif., San Francisco—A. D. Kern of Portland, Ore., has been awarded contract by the government for reinforcing and extending a jetty 300 ft. at Humboldt Bay and for the completion of a breakwater at Crescent City, at a cost of $300,000 and $200,000, respectively. Col. Herbert Deakdyne is chief engineer for the government in that district.

Calif., San Bernardino—Inland Oil Refinery Company, recently incorporated, will erect an oil refinery on West Rialto Ave. The plant will be erected in units, the first of which will cost approximately $100,000. The directors include Jefferson G. Crawford, of Los Angeles.

Utah, Salt Lake City—Stock Yards—Extensive improvements, including a new office building and extensions of stockyards, are planned at the Salt Lake Union Stockyard, to cost approximately $85,000. Thomas Austin is president of the Stockyard Company and J. H. Manderfield, general manager.

Wash., Tacoma—Gas Plant—Construction of a gas plant to cost $250,000 will be started very soon by the Tacoma Gas & Fuel Co., a subsidiary of the Standard Gas & Electric Company. The new plant will be erected on the site of the present plant and will double the capacity of the present tanks.

Buildings (Industrial)

B. C., Vancouver—Reports announce plans for pulp and paper mill costing $8,000,000 to be erected in North Vancouver, are nearing completion in the offices of the Seamon Paper Company of Chicago. It is stated new mill will have capacity of 250 tons daily and will employ 1,000 people.

Calif., Los Angeles — Frank D. Chase, Inc., engineer, 533 Title Insurance Building, is preparing plans for a 6-story, class A industrial building to be erected on Dowley Road, Central Manufacturing District for Los Angeles Central Manufacturing District Reinforced concrete construction, 6-story and basement, U-shape, 260 x 160 x 140 x 80 ft., 10-story tower, brick exterior walls, terra cotta trim, concrete and maple floors, composition roofing, tower to contain 150,000-gal. water pressure tank, freight and passenger elevators, club rooms for employees, sprinkler system, steel sash, rolling steel doors; $750,000.

Calif., Pasadena—E. D. Taylor, 539 S. Pasadena Ave., Pasadena, has the contract at $34,008 for erecting the new 1-story warehouse on S. Broadway, Pasadena, for the Crane Company. Cyril Bennett, 600 Security Building, Pasadena, architect. Mill construction, stucco exterior, foundation 144 x 148 ft., 3-in. wood floors, offices, storerooms, shipping platform, pipe sheds, fencing.

Calif., Los Angeles—Bavin & Burch Company, 173 E. Jefferson Street, was awarded the general contract at about $110,000 for erecting a 2-story and mezzanine story automobile building on Figueroa Street near Pico Street, for J. A. Graves. Morgan, Walls & Morgan, 1124 Van Nuys Building, architects. Dimensions, 100 x 155 ft.

Calif., Los Angeles—Architect A. C. Martin, 431 Higgins Building, is preparing plans for a 4-story and basement class A warehouse to be erected at Grand Avenue and 35th Street for the May Corporation. Reinforced concrete flat slab construction, 200 x 250 ft., composition roofing, cement floors, steel sash, 4 elevators, electric, steel rolling and metal doors, wire glass, basement 12 ft. deep; $400,000.

Calif., Los Angeles—Ashley & Evers, 58 Sutter Street, San Francisco, have prepared plans for a 5-story class A warehouse to be erected on Factory Place, near Alameda Street, for Dohrmann Commercial Company, 436 S. Broadway. Dimensions 135 x 150 ft., reinforced concrete construction, stucco exterior, steel sash, composition roofing, metal skylights, elevators, equipment, steel rolling doors; $180,000.

Colo., Lafayette—Work has been started on the main building of the factory of the Interstate Manufacturing & Roofing Co., the products of which will be slate-surfaced shingles and flat roofing material. Construction of the building and installation of machinery will require six months and will cost about $200,000. Harry S. Allen of Denver is president and general manager and George E. Bermont of this city, treasurer.

Ore., Portland—The contract for the addition to the Braly Motor Car Company, at 14th and Burnside Streets, was awarded to E. B. Gudhart, 986 Garfield Ave. The addition is to be 50 x 100 ft., 2 stories, concrete and tile, elevator—to cost $25,000.

Ore., Salem—Cuyler Van Patton has prepared plans for a 1-story concrete cannery building with basement, which Van Patton & Son will erect at Trade and Liberty Streets for the Northwest Canning Company. The size of the building is to be 96 x 148 ft. and will cost $40,000, and with the machinery complete will amount to $100,000.

Ore., Reedsport—A new sawmill will be constructed in East Reedsport, adjoining the platted section of the city, costing in the neighborhood of $250,000, and will have a capacity of 75,000 ft. daily. J. H. Austin of Reedsport made the announcement.

Ore., Portland—Camp & DuPuy have prepared plans and will erect a two-story warehouse and office building on East Washington Street near East 2nd Street for C. W. Nottingham, at a cost of $35,000.

Wash., Washougal—The buildings and equipment recently destroyed in the $100,000 fire at the Washougal Woolen Mills will be replaced by modern buildings and machinery.

Buildings (Miscellaneous)

Calif., Alameda—School—A bond issue of $750,000 was voted at a recent election here to be used for the construction of a high school.

Calif., Vacaville—School—Contract for the construction of the Vacaville Union Grammar School has been awarded George Barenchi, Vallejo contractor, at a cost of approximately $75,000.

Calif., Venice—Club—Architects Norenberg & Johnson, 401 L. A. Realty Building, have prepared preliminary plans for a class A club building to be erected on Ocean Front Avenue near Park Street, Venice, for the Oceanic Club. J. E. Hall, secretary. It will be 5-story and basement, 60x120 ft., reinforced concrete construction; $200,000.

Calif., Los Angeles—Hotel—Architect Harold Cross, 1132 Merchants National Bank Building, is completing plans for a 6-story Class A hotel building to be erected at Francisco Street and Potter Park Place for Frank G. and E. H. Jansen. Reinforced concrete construction, 90x100 ft., cast stone and face brick exterior, marble and tile lobby, comp. roofing, elevator, tiled baths, steam heating system, fire escapes, O. P. trimmings, 120 rooms, 85 baths, 120 toilets; $150,000.

Calif., Los Angeles—Hotel—Architect H. W. Charlton, 333 San Fernando Building, has completed plans and is taking segregated bids for the erection of a 4-story class C hotel building at 1043 W. 6th Street, for H. A. Strange; 106 rooms each with bath; lobby and restaurant. Cost, $1,000,000.

Calif., Los Angeles—Offices—Architects John Parkinson and Donald Parkinson, 420 Title Insurance Building, are preparing plans for a 12-story and basement class A office building, to be erected on Flower Street, near 8th Street, for the Los Angeles Gas & Electric Corporation. It will be 120 x 143 ft., and probably of steel frame construction. Cost, $1,000,000.

Calif, San Pedro—Apartments—Architect L. L. Jones, 603 Grosse Building, is preparing plans for a 4-story, Class C store and apartment building, to be erected at San Pedro for L. De Carlo. Brick 4-story and basement, pressed brick facing, composition roofing, steel beams, plate glass, metal sash, steam heating system, tile baths and drainboards, wall beds, electric elevator, ornamental iron, cement, hardwood and O. P. floors, staff; will contain 4 stores, lobby and 81 rooms, divided into 40 apts.; $150,000. Leased to Casson & Whilton.

Calif., San Francisco—Apartments—W. L. Growall is planning the immediate construction of an apartment building to cost approximately $500,000 at the southwest corner of Larkin and Chestnut Streets. Plans have been prepared by Wm. Knowles.

Calif., Sacramento—Hospital—W. C. Keating was the low bidder for construction of the Sisters' Hospital, to be located at 35th and J Streets. His figure was $398,800. R. A. Herold, architect.

Colo., Denver—School-Hospital—Alex Simpson of Denver has been awarded contract for the construction of the new state medical school and general hospital building for the University of Colorado. The estimated cost of the two buildings is $983,000.

Colo., Denver—Apartments—Permits have been issued for the construction of two four-story apartment houses, each to cost $300,000, by the Marion and Cecil Holding Companies of this city, for which W. N. Bowman is the supervising architect. Concrete for electrical work have been awarded to J. Fischer.

Colo., Denver—School—Excavation work for the new $100,000 Barnes Commercial School at Fourteenth and Glenarm Streets will be started shortly by the C. S. Lambie Construction Co. of this city. Fisher & Fisher are the architects.

Colo., Pueblo—Lodge—Plans for the erection of a business block on the site of the old opera house, destroyed by fire several months ago, have been set aside as the result of a purchase of the property by the Scottish Rite-Shrine Building Association, on which will be built a shrine temple to cost $700,000. The new building will include an auditorium to accommodate 1400 persons, ball and banquet rooms, in addition to commodious business quarters on the Main Street side of the building.

Colo., Denver—Hotel—A 12-story hotel with 600 rooms, to be located at Eighteenth and Broadway, has been announced by Edward S. Goldstone, head of a local investment company. It will be financed by an eastern concern for operation by a nationally known hotel company. E. H. Noorman of this city is the supervising architect.

Colo., Denver—Church—An addition to Temple Emmanuel, which will double the size of the building, is to be erected shortly at a cost of $200,000, according to Rabbi William S. Friedman.

Ore., Portland—Bank—Plans for a $40,000 building to house the Coos Bay National Bank of Marshfield, Ore., are being prepared by Tourtellote & Hummel. Plans are to be completed about June 1 and construction will start soon after.

Ore., Portland—School—Contract for general construction of the new Chapman School was awarded to Hilmer J. Stettergren; $203,495.

Ore., Forest Grove—Dormitory—Pacific University is to add a $50,000 dormitory for boys. The new building is a result of a gift of $100,000 to the college. The building will be three stories and basement and will accommodate about fifty students.

Ore., Portland—Apartments—An $80,000 apartment house is to be built at Denver Street and Watts Avenue for Sarah E. Parshall. The building will be of Spanish Mission style, of concrete construction and finished in stonetone; will contain 22 apartments. John H. Grant is the architect.

Ore., Astoria—Offices—A $250,000 four-story building is to be constructed on the block on 12th Street between Commercial and Duane. This is the largest building project announced for Astoria since the fire, and is to be built by Fred Warren and C. R. Higgins of Astoria and Charles Niemi of Seaside.

Ore., Astoria—Lodge—R. R. Bartlett, architect, has prepared plans for a $40,000 Masonic Temple to be erected at 16th and F Streets. The building is to be 3 stories in height, 60x80 ft. in size and will be built of reinforced concrete, and will be devoted entirely to Masonic purposes.

Ore., Salem—Residences—Lawrence & Holford of Portland are planning a residence for F. A. Livesley, local hop dealer, which will cost approximately $65,000. It will be built on Fairmount Hill and will be of the old English Manor type with landscape grounds. The same architects are also preparing plans for a $25,000 residence for Clifford Brown of Salem.

Ore., Tillamook—School—The general contract for the construction of the grade school here has been awarded to Hedges & Hulls of The Dalles on their bid of $68,757. The plans were prepared by A. E. Doyle of Portland and call for 16 class rooms, one-story, tile walls, rough plaster exterior, trimmed with terra cotta with tile roof.

Ore., Marshfield—Bank—The Coos Bay National Bank will start the erection of a $60,000 bank building on the corner of Central Avenue and Second Street. Tourtellotte & Hummel of Portland drew the plans, which call for a 2-story concrete structure with a white enamel finish in artistic design.

Wash., Seattle—Apartments—Hudson & Lorentz, contractors, will construct a new apartment structure, 3 stories and basement, of brick and concrete, 111x120 ft., to cost $150,000, at Second Avenue and Battery Street.

Wash., Chehalis—Apartment—Contract for the H. A. Kaufman apartment, to be built here at a cost of $85,000, has been let to Squires & Russell, Chehalis.

Wash., Snohomish—School—Snohomish School District has voted a bond issue of $80,000 to be used in constructing a new high school. Structure will be two stories and basement, 92x107 ft., of brick.

Wash., Seattle—Hotel—Eight contracting firms, six Seattle concerns, and two eastern companies, have been selected to submit bids on the proposed $3,000,000 Olympic Hotel to be erected here by the Community Building Company. Northwest fir is specified in the specifications.

Wash., Seattle—Church—The First Presbyterian Church, Rev. M. A. Matthews, pastor, plans the construction of a $1,000,000 Bible Building, adjoining the present church structure. The building will be 9 stories high, 110x130 ft. in size, and of concrete and steel construction. A feature of the building will be the electrical laboratory and radio station. The present radio station is to be greatly enlarged.

Wash., Vancouver—Lodge—Contract for the construction of the Knights of Pythias home has been awarded to Parker & Banfield of Portland on a bid of $99,800.

Wash., Seattle—Offices—Sound Engineering & Construction Company here received the contract for erecting Bigelow Building at a cost of $250,000. Building will be 60x120 ft., 8 stories high, of pressed brick and terra cotta.

Wash., Seattle—Offices—Contract for adding 5 stories to the Century Building, Third and Pike Streets, has been let to Murdock & Eckman, Seattle, on a bid of approximately $100,000. The addition will be of concrete and steel, and will provide an 8-story structure.

Wash., Aberdeen—Hotel—Washington Hotel Company has authorized A. H. Albertson, architect, Seattle, to proceed immediately with plans for proposed 5-story steel and concrete hotel, 130x100 ft., containing 125 rooms, to be built in Aberdeen.

Wash., Seattle—Apartments—Contract for a 4-story masonry apartment building, to contain 32 apartments, has been let by M. Riberg to J. Hokanson, contractor, 3626 Wallingford Avenue, at a cost of $60,000.

Wash., Seattle—Mausoleum—Pacific Mausoleum Association, American Bank Building, has commissioned Architect Andrew McQuaker to prepare plans for a $100,000 mausoleum of reinforced concrete, 183x62 ft. in size.

Wash., Seattle—Apartments—A. F. Mowat, Arcade Building, has received contract for a 5-story, $100,000 masonry apartment house, to contain 51 apartments and three retail stores, and to be erected by J. F. Fleming.

Wash., Everett—Hospital—Plans for the proposed 5-story steel and concrete hospital building, costing $300,000, to be erected by the Sisters of Charity of the House of Providence, are under way by Architect John Graham, Seattle, and bids will be called for shortly.

Wash., Seattle—Homes—Gardner J. Gwinn, realty operator, has purchased a large plot of ground in the Roosevelt School district, on which he plans the erection of 180 homes, ranging in cost from $5,000 to $8,000, and representing an expenditure of $1,000,000.

Wash., Seattle—Market—The Westlake Building Company will erect a two-story and basement, reinforced concrete and mill construction building, containing 60,800 ft. floor space, and costing between $90,000 and $100,000, at Westlake and Virginia Street.

Wash., Seattle—Office—Campbell Lumber Company plans erection of an $85,000 store and office building, two stories high, which will eventually be eight stories high and cost $250,000.